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13. ABSTRACT

This is a monthly publication presenting brief articles concerning recent developments in European scientific research. It is hoped that these articles (which do not constitute part of the scientific literature) may prove of value to American scientists by disclosing interesting information well in advance of the usual scientific publications.

The articles are written by members of the scientific staff of ONRL, with an occasional article contributed by a visiting stateside scientist.

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EUROPEAN SCIENTIFIC NOTES
OFFICE OF NAVAL RESEARCH
LONDON

Edited by John G. Foss and Victoria S. Hewitson

31 December 1971 Volume 25, No. 12

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AEROSPACE

EUROPEAN COOPERATION IN SPACE RESEARCH - A TIME OF TROUBLES

For about a decade various European countries have sought ways of cooperating in space research. Their basic motivation has been to be active contributors in an important scientific and technological area and to utilize the combined resources of the several countries to enter into this expensive arena with the giant programs of the USA and USSR. The concept is a popular one in Europe and reflects an important political motivation of the European Economic Community.

The chief organizational elements have been the European Space Research Organization (ESRO) and the European Space Vehicle Launcher Development Organization (ELDO). The two bodies have different functions but have highly overlapping national memberships and cooperate with each other (see ESN 24:9 pp. 280 and 283).

ESRO is devoted to collaboration in space research and technology for peaceful purposes and its aims are purely scientific. Thus it has not been concerned with construction of launching vehicles nor with projects of mainly commercial concern such as telecommunications satellites. The original membership was Belgium, Denmark, France, West Germany, Italy, Netherlands, Spain, Sweden, Switzerland and UK, with the major fiscal contributions coming from UK, Germany, France and Italy. ELDO, on the other hand, is concerned with development and construction of space vehicle launchers suitable for practical applications and for supply to eventual users. Its original membership was Belgium, West Germany, France, Italy, The Netherlands, The UK plus Australia. The large contributors of money have been UK, France and Germany.

The decision-making processes in both organizations reflect the primacy of national sovereignty in that a unanimous vote or a 2/3 majority are required for various significant issues. So long as national and collective interests coincided, this caused no difficulty. That happy situation did not last very long, and both bodies are currently in a state of some confusion.

The initiative for ELDO came from the British who wanted to develop their Blue Streak rocket, originally designed as a strategic missile, as the first stage of a heavy satellite launcher. An elaborate allocation of tasks was worked out for Europa I with UK responsible for the first stage, France for the second stage, Germany for the third stage, etc., and with Australia providing the Woomera launching site. The project never got very far before being succeeded by a more ambitious, four-stage concept, Europa II. This is the vehicle which was fired as part of a developmental series early in November 1971 from Kourou, French Guiana and failed. The primary operational task of Europa II is to be the launching of geostationary satellites for a European communications system, the Franco-German Symphonie.

While all this was going on, the UK decided it was uneconomical to produce the Blue Streak and the international multi-stage launcher compared with procuring similar vehicles from the United States, and indicated its intention to withdraw after fulfilling its existing commitments. This did not sit well, especially with France and Germany, who disliked the strings attached by the Americans. These were, primarily, that US launchers would not be used to put up telecommunications satellites except through Intelsat (international but dominated by the US) and that Europe ought to participate in post-Apollo programs. Very recently these conditions have been removed and proven American rockets have been offered at reasonable prices for essentially any purpose that is peaceful and consistent with existing international agreements. This change in attitude may, of course, be related to the recession now being experienced by the US aerospace industry. It now remains to be seen whether this attractive offer will be acceptable to the ELDO nations, for it involves giving up the attempt to create an independent European rocket industry and writing off some £250 M expended so far.

ESRO has had a more productive history. For example, over a period of several years European scientists were provided with sounding rockets and the means to instrument them competently. In particular, ESRO has supported the launch site at Kiruna, Sweden (68° N, within the Arctic Circle). In addition, ESRO has launched a number of small scientific satellites using NASA vehicles. This constituted a vigorous and scientifically useful program but one which was still small

compared to the American and Russian efforts. I am informed by a European scientist who has been close to the top echelons of ESRO that all this is in the process of changing since France has been insisting that ESRO alter its role to provide heavy emphasis on applications rather than science. So insistent are the French that they are reported to have given the required notice of intent to withdraw. Another scientist, who has used ESRO rockets and support in his program, told me that "ESRO is now dead," meaning that these stresses have closed that avenue for execution of his programs.

Discussions are now under way with a view towards shifting the responsibility for the Kiruna range from ESRO to Sweden. The Swedes are willing but are prudently requiring certain guarantees of paid usage of the range before taking over.

In the course of preparing this note, the European press has reported results from the December 1971 meeting of the council of ESRO. France has won its fight to convert ESRO from scientific to applied research and the ESRO convention has been so amended. A budget of $283.6 million has been adopted for the next three years for communications, weather and navigational satellites. This is reported to be adequate for one satellite launching every two years.

In line with the new goals, some of the ESRO institutes will be modified or abolished. In particular, the European Space Research Institute in Italy, a source of contention between France and Italy, will phase out its scientific work and this will be replaced by a transfer of functions from other ESRO institutes, such as the technical information service.

The council resolved that European launching rockets may be used provided their cost does not exceed 125% of the cost of the relevant non-European launcher. This response to the American offer of launch vehicles will have a profound effect upon ELDO. One finds it difficult to disagree with the appraisal of the London Guardian:

"Since US launchers are very much cheaper than anything which could be provided by ELDO in the forseeable future, the outlook for ELDO seems grim."

It does appear that this is the finish of ELDO as a developer of launch vehicles. The more restricted function of directing actual launchings is, however, still possible.

It is often said that the best and easiest way to demonstrate international cooperation is to use science as the example and the means. This is undoubtedly true because scientists are far more ready to cooperate across national boundaries than are politicans. We have been doing it in small ways for many decades. Now that the scope and cost are much larger, governments are directly involved, and this means that narrow questions of national self-interest and national pride will loom large. The tale of ESRO and ELDO suggests that even the high road of science leading to international cooperation is strewn with boulders. (S.L. Hess)

XXIInd INTERNATIONAL ASTRONAUTICAL CONGRESS

Brussels provided the colorful setting for the XXIInd International Astronautical Congress which took place from 20-25 September 1971. The headquarters of the Congress and the technical meetings were held in the Convention Hall (Palais des Congres) which is part of the Mont des Arts complex situated between the Central Station, the Place Royale and close to the Grand-Place and the SABENA Air Terminal. One could hardly dream of a more convenient location. Needless to say, the city fathers did their homework before creating these impressive facilities to attract large groups to their most beautiful and interesting city.

An International Astronautical Congress is organized each year by the International Astronautical Federation (IAF). The IAF is a non-governmental association of national societies founded in 1950 by Theodore von Karman and a group of devoted colleagues. It has continually grown in size from an original set of 11 members to its present family of 58 members in 36 countries. The aims of the IAF are to foster the development of astronautics for peaceful purposes, to encourage the widespread dissemination of technical information, to stimulate public interest in space flight through the major media of mass communications, to encourage astronautical research, to convoke congresses and scientific meetings, and to cooperate with other organizations in work related to all aspects of astronautics and the peaceful uses of outer space.

In 1960 the IAF created the International Academy of Astronautics (IAA)

and the International Institute of Space Law (IISL) which cooperate closely with the IAF although they function autonomously. A very interesting booklet entitled "The IAA - The First Decade" is available from the IAF Secretariat, 250 Rue St. Jacques, F-75, Paris 5, France for those who would like to become better acquainted with the Academy and its work. Prof. Stark Draper has been the President of the IAA since 1963. Prof. A. Jaumotte (Belgium) is the IAF President.

All of the participants were issued a book of abstracts for the multitudinous set of papers to be given during the week. Over two hundred papers were presented by running a number of simultaneous sessions covering the topics of Application Satellites - Meteorology; Safety in Youth Rocket Experiments; Astrodynamics I - Natural Motion; Application Satellites II - Earth Resources; Fluid Mechanics; Aspects of Space Flight; Organization of Space Agencies; Astrodynamics II - Motion Around Center of Gravity; Design Aspects of Scientific Spacecraft; Telemetering and Data Management; Propulsion; Astrodynamics III - Optimization, Education, Materials and Structures; Application Satellites III - Atmosphere and Ocean Pollution; Space Transportation Problems - Earth to Orbit; Bioastronautics - Life Support; Space Transportation Problems - Orbit to Orbit; Bioastronautics - Man-Machine; and Human Performances and Reliability, and so forth. For a copy of the complete program giving individual paper titles and authors, see the October 1971 issue of the AIAA (American Institute of Aeronautics and Astronautics) Bulletin. The complete proceedings of the Congress will be published and made available at a cost of $60 per set. Orders are presently being accepted by the Secretariat.

Thanks to the interest and individual initiative of its organizing chairman, Art Slotkin, editor of the AIAA Student Journal, the First IAF International Student Conference was held in conjunction with the Congress this year. For more background on this Conference see the September 1971 issue of Astronautics and Aeronautics. According to Slotkin, some 65 students from a number of countries assembled to participate, and apparently announcements concerning their desires and actions to set up an international student organization will be forthcoming. The students took a very active part in the Congress, and their indefatigable interest was a stimulating feature of the meeting.

Mr. Edward H. Kolcum writing in Aviation Week summed-up attitudes on Eastern European participation very well when he wrote that "Western delegates were disappointed in both the quality and number of Soviet papers. This meeting historically has been the forum in which the Russians were most candid about their successes and problems in space, but papers by the Soviet delegations were highly theoretical, and few dealt with experiments or operations."

Interest at the meeting was polarized on the future of space shuttle and tug programs, and on satellite applications. There is clearly a high level of world-wide interest in participating with the US in these programs. But the organizations and the agreements which would enable nations to share the costs and the peaceful use of space are totally lacking. To make any headway in these matters will require both imaginative leadership and a genuine desire and willingness to forge international multilateral cooperation.

Emphasis on satellite applications, particularly in monitoring the environment, was one of the Congress highlights. As a result, a large number of papers discussed the way space will be exploited to sense, monitor and predict pollution and the degradation of the environment.

Plans have already been developed for the XXIII International Astronautical Congress to take place during the period 8-15 October 1972 in Vienna with the speculation that in 1973 it may be held in the Soviet Union. There is no question in my mind but that these International Congresses in Astronautics serve mankind by bringing men of goodwill together to discuss technical problems of common interest to all. (A.A. Ranger)

INSTITUT FRANCO-ALLEMAND DE RECHERCHES DE SAINT-LOUIS

The Institut Franco-Allemand de Recherches de Saint-Louis, or ISL, is located on French soil just a few kilometers from Basel, Switzerland. This Institute has a rather unique history which I will attempt to briefly recount before describing the technical

activities and the impressions received during a recent visit there.

The Institute was founded and previously located in Berlin to study the broad range of problems associated with ballistics. But as the Russians approached Berlin, Dr. Schardin fled with his group to a region of Germany which was later occupied by the French. It was at this point that the French proposed that Schardin and his group continue their ballistics research under their guidance. Schardin accepted and shortly thereafter they were moved to St-Louis and occupied buildings that had previously housed an aluminum factory. Apparently St-Louis was chosen as a site for relocation as suitable facilities were available on French soil which, because of their close proximity to the German town of Weil am Rhein, afforded the German scientists an opportunity to live in Weil and commute daily to France to work. Until about 1959 when Germany was allowed to rearm herself, the Institute functioned under a French director and board of directors. Since this time, however, it has been guided jointly by a German and a French director who have equal administrative responsibilities. Truly a unique scientific enterprise to this author's knowledge. The first German director was Schardin who was later succeeded by Prof. R.E. Kutterer in about 1965. In August 1969, Dr. R. Schall was appointed to fill the vacancy left by Kutterer's retirement. Dr. Auriol is his French counterpart.

Schall who served as my host explained that the board of directors is composed of nine members from Germany and an equal number from France - representing the University, Industry, and the Ministry of Defense. Apparently, each of these three groups has an equal voice in policy decisions. It is the task of the board to formulate and elucidate the specific areas of research that the Institute will undertake. Once these plans have been laid it is the directors' responsibility to see that the work is accomplished. The two directors and their respective staff have an input in the policy-making decisions by advising the directing board as to the areas of research they feel should be pursued. Obviously, the research done here must, of necessity, be of interest to both of the countries involved.

Schall further explained that 80% of the research effort is devoted to what he described as applied problems of specific interest while the remaining 20% is reserved for individuals to follow lines of inquiry which may or may not have direct relevance to the specific tasks of the Institute. Certainly this is an attractive organizational feature as it fosters an element of individuality and creativity in the staff. However, he added that more and more it is becoming necessary to justify the research being undertaken in terms of its applicability to a specific and immediately identifiable problem area.

The Institute employs a total of approximately 500 people, and currently operates on an annual budget of about $7,000,000 which is mainly derived from the Ministry of Defense in each country plus some supplemental contracts from other governmental agencies. No contracts from abroad are held and little or no work is done for industry. Two-thirds of the annual budget goes immediately for wages and salaries while one-eighth is appropriated annually for new equipment. Plans had called for adding modestly to the staff, but the sudden rise in general salary levels in Germany and France over the past few years has wiped-out all hopes of increasing the number of personnel at this time as the annual budget has reached an equilibrium condition at its present level.

Schall mentioned that the Institute focuses its attention on seven major areas of investigation. These he enumerated as strong shock waves, weak shock waves, laser applications, impact phenomena, ballistic phenomena, hypersonic wakes, and high speed photographic development. Recently, they have also become involved in some inter-disciplinary research combining efforts with psychologists, physiologists, and animal scientists to study the effects of sonic boom on human beings and on cows, chickens, etc. Obviously, these studies were undertaken in connection with the Concorde program.

Numerous shock tunnel and shock tube facilities are being used in the experimental studies. One shock tunnel I examined was of the non-reflected type - being driven by cold hydrogen at a maximum driver pressure of 1000 atms. The main interest here is in making heat flux measurements and shock layer density profile measurements using thin film gauges and a laser interferometer diagnostic technique, respectively.

Another problem of interest is the motion of the cloud of tiny particles in a high speed flow. Experiments to

determine the drag coefficient of such a cloud are being carried out in a shock tube by injecting the particles into the windowed test section of the tube where they are subjected to the high speed flow set in motion by the propagating incident shock wave. A laser Doppler technique is being used to measure the time history of the velocity of the particles.

Naturally, light gas guns are also a major research tool at the Institute. Several guns of various sizes are in use to establish hypersonic flight of small projectiles for ablation and heat flux studies, creation of hypersonic wakes, and impact studies. These bodies are launched using a standard Sabot technique and recovered at the far end of the range from a mass of polystyrene. The main diagnostic technique is again photographic - using pulsed laser light sources to obtain schlieren and interferometric photographics of the flow field.

An area of research which, unfortunately, is currently undergoing a marked reduction in emphasis is that of supersonic combustion. Studies have been underway here for some time on the detonation and deflagration of hydrogen-oxygen and methane-air mixtures as induced by the flight of high speed projectiles through them. Beautiful pictures have been obtained of the reactions initiated by both blunt and cone-shaped bodies delineating the specific conditions under which one obtains deflagration, unstable combustion, and fully established detonation. This work is very similar to that of Prof. T.Y. Toong at MIT.

An extremely simple, inexpensive, and fascinating high speed shuttering system is used to photograph the projectile initiated combustion. A 10-μsec shutter is achieved by detonating a small explosive squib to expel lampblack powder into a clear glass chamber placed immediately in front of the camera lens. Twenty-four individual shutters of this type together with a multispark discharge light source and a 24-frame Schardin camera were used in these studies. Since I had never seen such a system before, I was immediately attracted to it. The photographs obtained are of the highest quality.

A considerable effort is being devoted to the development of a double-beam laser Doppler flow diagnostic system. Apparently, this work was begun some five or six years ago and has, at this point, been developed to give some satisfying results. Flow velocities behind propagating shock waves in a shock tube are being determined by measuring the Doppler shift in frequency of the light scattered from the dust particles in the tube. This diagnostic technique is also being used to measure the fluctuating velocity components in a turbulent flow field.

Aside from the work already mentioned, there is also a substantial effort being put forth to develop holographic techniques and to study laser generated plasmas.

I was very much impressed with the adequacy of the facilities, the motivation of the personnel, and the obviously high quality of the ballistics research which is being conducted at ISL. It is clearly the outstanding Institute of its kind in Europe, and from all appearances it will remain as such for many years to come. Besides, if your mother tongue is one of the three - English, French, or German - you will feel right at home. Everyone I met and talked with was at least tri-lingual!
(A.A. Ranger)

BIOLOGICAL SCIENCES

THE NEUROLOGICAL LABORATORY AT THE ROYAL COLLEGE OF SURGEONS OF ENGLAND

Housed in the magnificent building of the Royal College of Surgeons, in Lincoln's Inn Fields in central London, are the several departments of the Institute of Basic Medical Sciences. The Institute, a unit of the University of London, has as its primary function the training of postgraduate physicians who wish to qualify in surgery. Students take an eight-week, full-time course in physiology, anatomy, pharmacology, biochemistry and pathology in preparation for the qualifying examination in the basic sciences. (Clinical training and examinations, which, along with those in basic science, lead to full qualification as FRCS, are a separate topic in themselves.)

The Department of Applied Physiology, headed by Prof. D. Slome, is responsible for all teaching in physiology in the various postgraduate courses conducted by the Institute. This includes lectures and demonstrations to all the students in surgery, anesthesia and dental (maxillofacial) surgery.

The division of neurophysiology (the Neurology Laboratory) of the Depart-

ment of Applied Physiology is headed by Dr. B. D. Wyke, a very genial gentleman and capable investigator who has headed the Laboratory since 1963. He spent several years in the United States in the 1940's and '50's, training in neurosurgery and neurophysiology, and has returned there several times since. Wyke was my host on a recent visit during which he described the teaching activities of the Laboratory, showed me around the College with its many historical treasures, and discussed his research work.

Wyke's interest for several years has been the neurophysiology of joints and the reflexes initiated in them. In each case, he has directed the work towards clinical problems associated with malfunction of the particular joints or of their innervation, often in collaboration with clinical colleagues.

In the realm of orthopedic neurology, for example, studies on the ankle, knee and hip joints have been completed over the past few years, and Wyke is now investigating spinal joints. Through meticulous dissection, preceded by careful histological studies, he has been able to isolate and stimulate nerves arising from the capsule of cervical joints in the cat. Electrical stimulation of these elicits characteristic reflexes in musculature of the trunk and limbs. Most interestingly, one reflex is characterized by a very long latency (several seconds) and considerable persistence. These characteristics and the overall pattern of response are typical of the classical Magnus-DeKluyn reflex which Wyke is now inclined to believe arises from spinal joints rather than (or in addition to) from the vestibular apparatus.

A second topic, very important in orthodontics and maxillofacial surgery, is the contribution of the nerve supply of the temporomandibular joint to normal and abnormal mastication. Again, working with the techniques of selective stimulation of afferent fibers from the joint capsule and myography of individual masticatory muscles, Wyke and his colleagues have characterized the types and distribution of sensory endings in the joint, and the reflex patterns associated with their activation.

Finally, Wyke, in collaboration with laryngological colleagues, has looked into the innervation of laryngeal joints and the reflexes arising from them which affect both intrinsic and extrinsic laryngeal muscles. Currently, Wyke is investigating the laryngeal mucosal reflex, whereby alterations in pressure on the mucosa (brought about by changes in air movement - as in speech and respiration) initiate responses in laryngeal and glottal musculature. These studies have obvious relation to mechanisms of phonation, and the relationship between speech and respiratory control. As an outgrowth of this interest, Wyke has organized a closed symposium on respiratory and laryngeal control systems to be held at the Royal College of Surgeons in January, 1972, which I hope to attend and report on. (R.R. Sonnenschein)

DIATOMS AND DROWNING - FORENSICS AND PHYTOPLANKTON

It is an old story, in both fact and fiction, for a coroner to autopsy a body fished from the river and, on the basis of the presence or the absence of water in the lungs, to decide whether the subject drowned, or whether he had been done in by other means and the river was merely the site of convenient interment. But the value of the water-in-lungs approach depends heavily upon the time interval between death and the autopsy, and it is of little value if the body has been immersed for a long time. Now it appears that aquatic microbiology may occasionally afford some additional information - not only Whether? but Where? And it's done with Bacillariophyceae - diatoms. These are microscopic, unicellular greenish-brown plants. They occur in both salt and fresh water; they are the "grass" of the watery world; they do most of its photosynthesis, and as such, they are the base of the aquatic food chain. Some of the smallest are perhaps 4 or 5 μm in their greatest dimension, most are in the 20- to 150-μm range. There is an enormous variety, perhaps 15,000 species. Freshwater types are not easily confused with marine or with brackish-water species. And in each of these three media, local factors can modify or control species distribution. Of crucial importance here is the enclosing box-like cell wall (the "frustule") which the diatom secretes. It is highly distinctive, and being made of silica, it is very durable, persisting in its characteristic form for aeons after the diatom has died.

It would be significant indeed if a body found floating in the sea off Belgium contained diatoms characteristic of, say, the Thames estuary. (Hendey, N. Ingram (1964) "An Introductory Account of the Smaller Algae of British Coastal Waters. Part V: Bacillario-

phyceae (Diatoms)" HMSO London.) And please note, the proponents of diagnosis by diatoms do not look primarily at the lungs. Indeed, they make special point that particulates (diatoms included) suspended in water inhaled by the drowning man may penetrate the lung alveoli and be carried by the blood to various organs where they can be detected by appropriate postmortem techniques. It is authoritatively stated that diatoms have been detected for forensic purposes, in the bone marrow.

This interesting topic was brought to the writer's attention by a friend, N. Ingram Hendey, author of a definitive treatise on diatoms (ibid.). He had just given a paper on the subject at a London meeting of the British Association in Forensic Medicine. Hendey is a marine biologist, so he did not deal with postmortem examinations except for the separation and identification of diatoms from tissues. It appears to me that the critics, by not considering species identification, have been misled into deprecating the possibilities of the method by the obvious false positives, i.e., non-drowning cases in which diatoms are found. Of course there are false negatives, cases of known drownings where diatoms are not found.

There is not much one can do about negative tests, but I think Hendey is making a real contribution in pointing out that the confusion about the positives can be clarified by biological identification of the diatoms found in the subject and similar characterization of the diatoms occurring at the presumed site of the splash. For it is crucial to establish whether diatoms found in the tissues are indeed characteristic of the place where the body was retrieved, or of the place where it is believed to have entered the water. And here Hendey very properly stresses the importance of micro-habitats. He uses a ditch as an example. It is very non-uniform: it may narrow suddenly, to make a local increase in the flow rate, or it may deepen to make a semi-stagnant pool; at one place there may be drainage from a farm, rich in nutrients. At another, the bottom may be rather clean, with bare stones and pebbles, at still another, the ditch may receive a shower of leaves which decay and produce a still different environment. In each of these situations certain species will flourish, others will flag. And there are other factors. For instance, ejecting an adult body into an aquatic medium introduces a considerable amount of kinetic energy. If the water is shallow, the bottom will be stirred up and the significant debris will include sediment with the frustules of the last year's diatom crop.

Hendey offers other caveats on getting truly representative samples, and he outlines two methods for oxidation of the extraneous, obscuring, organic matter: acid permanganate and sulfuric acid-sodium nitrate. The frustules, being made of silica, are generally resistant to acid, though the frustules of marine species are much thinner and more likely to break up than those of the freshwater types. The non-digestible residue is suspended in an appropriate mounting medium and examined microscopically.

To this observer, the most surprising aspect is that diatoms are found in tissues other than the lungs. But there seems to be ample evidence that body tissues and membranes are penetrable by small particulates. Detection of diatoms in bone marrow is in the literature (Timperman, J. (1969) "Medico-Legal Problems in Death by Drowning, Its Diagnosis by the Diatom Method" J. Forensic Med. 16, 45-75 (75 refs)). They have been found also in the liver, kidney, heart and brain, carried thence by the blood during the process of drowning. Hendey properly warns that diatoms are part of our everyday environment, from heat-insulating materials to filter aids, to the dusting powder on surgeon's gloves, so special heed must be given in showing that the diatoms of the postmortem study could have come only from the flora of the suspected immersion site. There's lots of work here, for marine biologists, physiologists, as well as men of forensic medicine, although the 'diatom test" is now accepted in the English courts as proof of death by drowning.
(J.M. Leonard)

EARTH SCIENCES

OBSERVATOIRE SEISMOLOGIE ET METEOROLOGIE, MONACO

Although Monaco is a very small country, the recent Princes of Monaco have had a strong personal interest in scientific activities. It was under Prince Albert that the Museum of Oceanography was founded. It is rather ironic that its world-wide reputation is primarily based on the achievements of its director, Jacques

Cousteau and that its failure to develop further is also aggravated by the many and prolonged absences of the Director. It is important to note that the Museum of Oceanography is really a private French organization much of whose every day funds are provided by fees paid by visitors to the Museum. Its funds for scientific research are received through research contracts primarily from such organizations as CNRS (Centre National de la Recherche Scientifique), the French Petroleum Institute, the Military Ministries and NATO. Salaries are provided by such research contracts.

On the other hand, we have the Centre Scientifique de Monaco, which is a purely Monacan institution, that receives its budget from the Government of Monaco. It was founded by S.A.S. Le Prince Rainier III on 23 May 1960, and although it is physically located in the Museum, it is not part of it. Its President is currently Arthur Crovetto, who is also Monsieur le Ministre Plenipotentiaire. It is composed of three laboratories: (1) the Laboratoire Radioactivite Appliques, established in 1960, and headed by N. Thommeret, (2) The Observatoire Seismologie et Meteorologie, established in 1963, headed by L. Grinda, and (3) the Laboratoire de Microbiologie, established about 1967, and headed by Prof. Vaissiere. This latter Laboratory is primarily involved in marine pollution, which is a strong personal interest of Prince Ranier.

The total staff of the three laboratories numbers eight scientists and four secretarial and technical assistants. This may sound rather small, but when we consider that the Principality of Monaco numbers only 30,000 people, it assumes a rather large size.

We are here concerned only with the activities of the Observatoire Seismologie et Meteorologie, manned by Commander Grinda, Alain Vatricam and a secretary. The secretary also develops the records, changes the paper, etc. Grinda left the French Navy in 1953 (the possibilities at that time were not too interesting) and joined the Museum of Oceanography as administrative assistant to the Director, a good friend of his. He had previously developed a strong interest in meteorology, having even taught it to officers of the French Navy, and was also considered an expert in submarine explosions. During '53-'55 he spent some time sailing around the vicinity of Monaco studying water temperature, salinity and marine acoustics. In 1955, he was asked to assume the duties of managing a seismic station which had been established at the urging of Prof. Coulomb and Prof. Rothe in order to have a station south of the Alps. The seismic station is presently equipped with three components of Teledyne LP instruments and a SP-Z Grenet seismograph. By the end of the year, he plans to have two more horizontals in operation (either Askania or Teledyne). Timing will also be improved, since the Prince has recently ordered a new French quartz clock with an accuracy of 1/1000 second for the Monacan time service. A line will be installed to the Observatory.

Thus, seismological observations began in Monaco for the first time in 1955 and have been continuous since then

Both Grinda and Vatricam are self-taught seismologists. Grinda knew nothing about seismology when the station was established in 1955. However, this was corrected by the process of looking at a lot of records and spending an intensive year with Bullen's book. Anytime that he really got stuck, he would call or write his friend Rothe for advice and assistance, which was always forthcoming. Vatricam came to Monaco about three years ago after receiving his degree in electrical engineering from the Polytechnical Institute of Grenoble. He, too, has learned his seismology and oceanography on the job.

Because of Grinda's background in oceanography, and because the organization is, after all, an observatory of seismology and meteorology such as: (1) study of the SOFAR (sound fixing and ranging) channel in the Mediterranean, using T-waves (Transverse waves) from Algerian and Tunisian quakes (he found that the channel only exists in the summer months in this part of the Mediterranean), (2) the study of the interrelationships between sea level, tides and atmospheric pressure in Monaco and Nice, (3) microseisms, and (4) the effect of the Mediterranean on local weather patterns. It is rather amazing that Grinda has found the time to work in all these interrelated problems.

The second major research area

is the structure of the Western Mediterranean particularly as it relates to global tectonics and the interaction of the African and European plates. In this area, too, Grinda presented a paper in Rome (in December), based on his seismicity studies of the Western Mediterranean region, which pretty much supports the current ideas of LePichon and McKenzie. His primary research interest is, however, in the origin of microseisms. He first presented his new theory for microseisms in Zürich in 1967, and further amplified it at the recent microseismic conference in Paris. At the time of my visit, he was busily engaged in compiling new data that was presented in Moscow in August ('71).

In seismology, it turns out that there are 10-12 quakes per year between Genoa and Nice. There is an interesting active area not too far from Monaco in the Ligurian Sea which has been the locus of several large shocks as well as earthquake swarm activity (i.e., in July '67, the swarms lasted a month). In 1887 a quake of intensity 9-12 occurred here which was felt in Corsica, and another on 6 May 1963. There have been two quakes from the same region since that time that were felt in Monaco. This area is of particular interest to the Observatory, not only because of the possible potential danger, but because the focus seems to be of a collapse type. The P-waves (Body waves) in all quadrants are negative, but in most cases they are so small as to make the conclusions somewhat controversial. At any rate, the conclusions do support Grinda's hypothesis that Sardinia is drifting eastward.

The Observatory has no shortage of data with which to work. Besides the data from their own seismic station, they receive data from all the surrounding countries. They, of course, receive the daily weather charts, tide records, etc. In addition, they have a rather complete record of meteorological data for the last 60 years from the large meteorological station at the Nice airport. Grinda feels that the two-day forecasts on the daily weather charts are not so good, primarily because the interaction between the Mediterranean and the secondary lows passing over it are not well known. This situation causes rapid and often intense weather changes in this part of the world and is thus considered to be an appropriate research problem for the Observatory. (R.E. Hanson)

GEOPHYSICS IN SPAIN

Perhaps it would not be amiss to quote a few paragraphs from the opening speech of Manuel Lora-Tamayo at the recent IAGA-IASPEI (International Association of Geodesy-International Association of Seismology and Physics of the Earth's Interior) meetings in Madrid: "The study of Astronomy and Geophysics in our country dates back to Seneca. They acquired special importance in the schools of Cordoba and Toledo and in the scientific center which Alfonso X, the Wise, established there, gathering nearly fifty of the best astronomers and mathematicians, native as well as from the Near East, in order to elaborate the famous 'Tablas Alfonsinas.' Later on, the discovery of America, the great feat of the Catholic Kings, and the travels through the Oceans posed new problems which had to be faced by the royal cosmographer Jaime Ferran. Meanwhile, in 1530, Alonso de Santa Cruz, astronomer and geophysicists, completed for the first time a graphic table of magnetic declinations and thus became, along with Burroughs, a precursor of Halley.

"We might also note the fact that the University of Salamanca was the first to include in its programs the heliocentric doctrine and that the first legislation concerning the construction of earthquake-proof buildings was carried out by the Council of Indies in the reign of Phillip II. The names of the sailor Jorge Juan and of Ulloa, who in the XVIII century took part in the measuring of the meridian arc of Peru and the installment of the Cadiz Observatory, which would later on belong to the San Fernando Marine, constitute landmarks in the development of the Sciences of the Earth in our country ..."

Nevertheless, today, basic research in solid earth geophysics is not well supported in Spain nor are there many opportunities for a student to find a job. Although some limited work is undertaken at the Universities of Madrid and Barcelona, the only institution of practical importance is the Instituto Geografico y Catastral, a government organization, in Madrid.

Although, by law, the Spanish

Parliament includes representatives of the Universities, the Royal Academies, the Institute of Spain, the Consejo Superior de Investigaciones Cientificas (CSIC), and the professional colleges, this is, in numbers and in weight, a very small voice. In general, it can be said that the government is not wild about the support of science.

The Ministerial Departments are responsible for the conduct of science pertaining to their specific activities. The CSIC, the highest research organization of the country, is the responsibility of the Ministry of National Education. The Instituto Geologico y Minero is under the Ministry of Industry, as is the Nuclear Energy Commission. The Instituto Geografica is under the Presidencia del Gobierno, which is a high-level Ministry presided over by the Vice President of the Government. The Institute of Oceanography is under the Ministry of Commerce. The military ministries also have centers of their own, i.e., the Military Geographical Service dealing with military aspects of geodesy.

The CSIC, often called the Spanish Research Council, should be the most important research organization in Spain, but at least in the field of geophysics, it is not very effective. It was created in 1939 with the function of fostering, directing and coordinating Spanish scientific research. It absorbed several preexisting organizations.

A general Assembly of the CSIC is held once a year, attended by members of the Consejo from all over Spain. Members are from the Royal Academies, the universities and engineering colleges, theologians, librarians, archivists and outstanding persons in the field of private research and industry. They discuss the work achieved over the past year, the annual expenditures, the plans to be carried out in the coming year, and general policy to be followed. An Executive Council, which meets once a month, discusses the organization and administration of scientific research in the Consejo. A Permanent Commission meets at least once a fortnight to handle business transactions and paper submissions for the Executive Council.

Although the Consejo encourages private and individual research (within its own Institutes and "collaborating" institutes), its tendency is to carry out research of a collective nature which is deemed to be of benefit to the nation. Organizationally, the Consejo is divided into eight divisions called "Patronatos" (named after famous Spanish scholars and scientists), each of which consists of a series of Institutes and Centers of Research. From the standpoint of science, the four most important are:

"Juan de la Cierva" ... technical research - also helps financially the laboratories of the universities and technical schools.

"Alonso de Herrara" ... biology, botany, geology.

"Ramon y Cajal" ... sets up, directs and coordinates medical science and animal biology.

"Alfonso el Sobio" ... mathematics, physics and cosmology.

The latter three divisions form together the Sciences Division of the CSIC. The other four Patronatos deal with theology, philosophy, law, economics, history, arts, Spanish life, and international studies. The CSIC also contains a Data Processing Center.

The only CSIC-sponsored laboratory in solid earth geophysics is the National Geophysical Institute in Madrid. Although it has an elaborate structure, it is essentially a paper organization that does little but maintain a library and publish the Spanish geophysical bulletin. It is unfortunate that the CSIC has not seen fit to make this organization a viable geophysical institute. Perhaps they will in the future. On paper, though, it has about 30 members, appointed by the National Research Council and divided into eight sections: Pure Geophysics (five members), Applied Geophysics (four members), Pure Meteorology (four members), Applied Meteorology (two members), Radioactivity (one member), Theoretical Radioactivity (two members), Radiophysics (one member) and Radiochemistry (one member). There are two collaborating institutes: Ebro (with two representatives) and Cartuja (with one). There are three other collaborators, whom I don't recall. The various sections meet only rarely and such work as is transacted is done by the President (Prof. Dr. Luis Lozano) and his two-man staff.

The Instituto Geografico y Catastral was founded in 1869, primarily due to the efforts of General Ibanez de Ibero, who was one of the founders of the International Association of Geodesy and served as its president. Within the Instituto are the National Services of Seismology

and of Geomagnetism. The address is General Ibanez de Ibero, 3, Apartado 3007, Madrid 3.

The Laboratorio Central del Servicio de Sismologia is an office with the primary duty of preparing the Boletin de Sismos Proximos (local and near earthquake bulletin) using Spanish data together with other information received from French, Algerian, Portuguese and Moroccan stations and of providing technical advice to the Section of Geophysical Observatories. Some research work is also carried on.

The Instituto Geografico is headed by a Director General, and is divided into seven main divisions. By far the largest effort is in the area of mapping and land surveying, primarily for the purpose of land title and taxation. We are here most interested in one of the smaller Divisions "Geodesy and Geophysics," under the direction of Dr. Ing. D. Jose Munuera. This Division is presently divided into seven sections: (1) Geodesy, (2) High Precision Leveling and Sea Level, (3) Gravimetry, (4) Seismology and Engineering Seismology, (5) Geomagnetism and Aeronomy, (6) Meteorology, and (7) Geophysical Observatories.

Within the Institute, and directly under the Director General is the Spanish National Committee of Geodesy and Geophysics (as well as the National Committees for Astronomy and for Meteorology). Of course, membership in these important committees are not limited to scientists of the Institute, but are drawn from all over Spain. It might be mentioned in passing that the National Committee for Geology is similarly housed under the Director General of the Instituto Geologico y Minero.

The 800 employees of the Institute are divided somewhat as follows: (1) 100 are senior technical staff, (2) 450 are second-level technical and scientific staff termed "surveyers," and (3) 250 technical assistants, including drafting, administrative assistants, etc.

Thus, in the Seismology Section, we have three scientists, two surveyers, and three technical assistants. The head of the unit is Dr. Ing. D. Julio Morencos. Actually, he is working in geodesy, and is about to become the head of a new "Centro de Estudios Geograficos, Geofisicos y Astronomicos." This new Center, which will be directly under the Director General, is planned to include all the research work in the Institute. This implies, I suppose, that everyone else will do only the routine work. If this is so, it sounds like a rather sad arrangement (for those not in the new Center). The acting head of seismology is Dr. Ing. D. Alfonso Lopez Arroyo. He is assisted by Mr. Serrano. Augustin Udias, S.J., also works here part time, supported by grant funds, but is not a member of the staff. The third seismologist in Spain, Dr. Ing. Gonzalo Payo is an employee of the Institute, but is physically located in Toledo.

The Gravity Section is headed by Dr. Ing. Alonso Sanmillan and includes two Inginiers, two surveyers, and two technical assistants. The Geomagnetism and Aeronomy Section is headed by Dr. Ing. D. Luis De Miguel and includes two surveyers and two assistants. He has a big job to do, in that the bulletins of two of the permanent magnetic observatories are prepared in Madrid. The High Precision Leveling and Sea Level Section is headed by Dr. Ing. D. Jose Maria Raposa, assisted by five surveyers and two assistants. The Geodesy Section is headed by Dr. Ing. D. Jose Maria Turnay, with five senior staff, three surveyers, and two assistants.

The newest section is "Geophysical Laboratories" which is in charge of the seven Observatories in Spain. This, again, doesn't seem to be the best type of organization, separating, as it does, the scientists from their instruments by an intervening administrative unit, but there are possibly some good reasons for it.

Seven seismic stations are operated by the National Service of Seismology. Two are WWSSN stations: Toledo and Malaga. Three are more local stations, each with 3-component Hiller-Stuttgart seismographs: Alicante, Almeria and Logrono. Two stations are outside of Spain: Tenerife and Moca. These stations also have Stuttgart-Hiller seismographs. In addition, there are four private, collaborating stations which have been in existence a long time: Cartuja (1903) and Ebro (1904) operated by the Jesuits, Fabra (1906) operated by the University of Barcelona, and the oldest of all, San Fernando (1899) which was set up and is still operated by the Navy.

There are five permanent magnetic observatories in Spain, all collocated with seismic stations. Three are run by the Instituto: Almeria, Logrono and Toledo. Two are private: Ebro and San Fernando.

Udias, Lopez-Arroyo and Payo are

attuned to the modern ideas of geophysics. However, most of the geologists - there are a counle of notable exceptions - are doing traditional geology and have little interest in the newer theories.

The Central Observatorio Geofisico de Toledo was initially founded in 1909 as a seismic station in the town (1909-1931). The building is now the Deputation. The seismic station moved to its present enviable site outside the town in 1931. In 1940 the Department of Geomagnetics was added, which has all the standard equipment to measure Z (intensity of vertical component), H (intensity of horizontal component), D (declination), I (inclincation), to make the absolute measurements to check the variometers, a proton magnetometer, etc. In 1947 the earth current installation was established. This installation has not been in operation for about three years because of disturbances caused by the electric railroad. However, they do have a good file of records. Recording has again been initiated in a new and quiet site about 60 km south with little danger of a railroad in the future. Part of the magnetic section will also move to the new site. Payo would like to initiate paleomagnetic work in Toledo.

The staff at Toledo numbers 13, and is under Payo's direction. The research staff is very small - includes Payo and two topographers: Eliseo Ruiz De La Parte (seismology) and Rafael Gomez Menor (geomagnetism). The remaining staff members include two gardeners, three to develop records, etc., one driver, an administrator, a mechanical engineer, and two girls (one in seismology and the other in geomagnetism). Several families live at the Observatory, and much of Payo's time is involved with the various problems of his large "family."

The biggest project he has undertaken recently is the installation of a VLP (very long period) seismic station. This had really occupied a very great deal of his time in dealing with public relations, contractors, Madrid, etc., etc. A 25-km tunnel has been constructed in good granite close to town, but on the other side from the Observatory. The three tanks are installed at the back of this tunnel behind two pressure doors.

The seismic station at Toledo is a WWSSN station with three standard SP Bennioffs, and three LP Sprengnethers, together with three modified Wiecherts recording on smoked paper.

Payo is possibly the best seismologist in Spain and is certainly the most efficient and hard working. Although he doesn't dislike working alone, his research output (not inconsiderable) would be enhanced by some help. This Central Observatory is the only one of its kind in Spain, but lacks a staff of investigators. Payo would like to see a staff of about 40, but at present there are no positions, nor do the administrators in Madrid seem to be pushing very hard to establish them. Nor is money available for a variety of research projects that could be done. Payo was fortunate to obtain a small grant from the Juan March Foundation last year that makes possible his present research.

The universities in Spain are under the Ministry of National Education. Spain is divided into 13 university districts, in the capitals of which the respective universites are located: Barcelona, Granada, La Laguna, Madrid, Murcia, Oviedo, Salamanca, Santiago, Sevilla, Valencia, Valladolid, Zaragoza and, the newest, Bilbao. Because of the very rapid growth in student enrollment since 1960, some of the university districts have new additional Autonama universities (i.e., Barcelona and Madrid). Some of the universities have established Branches in other towns (i.e., the Malaga branch of Granada Univ., the Babajoz branch of Sevilla Univ.). Until last year, the Technical Schools were almost entirely supported by the Ministry under which they operated, but they are now a part of the State System.

Five universities have departments of geology (Madrid, Barcelona, Oveido, Granada, Bilbao) that teach a course or two in applications of geophysics to geology, but it is only within the Universities of Madrid and Barcelona that geophysics is actually taught and some research may be undertaken. Those desiring to be applied geophysicists, generally enroll in the Mining Engineering schools. The Technical School of Mines in Madrid, for example, includes applied geophysics in its curriculum, but there is no research. The Internal Geodynamics Department of the University of Madrid uses geophysical equipment in studying problems of tectonics and geological history.

Two rather famous Jesuit Observatories have recently become semi-incorporated into the State University System. The Observatorio del Ebro at Tortoso has moved its geophysics library (the best in Spain) to the University

of Barcelona. Also many of its senior personnel have taken on teaching positions in the University (e.g., P. Jose Oriol Cardus, S.J., in geomagnetism and Rev. Galdon, S.J., in solar physics). The Observatory itself remains in operation under the Jesuits. Similarly, the Fathers at Cartuja have taken positions at the University of Granada. However, their more senior members have recently retired so that the impact is not very great.

The Instituto Geologico y Minero, under the Ministry of Industry, has the job of drawing up the Geological Map of Spain and of undertaking hydrogeological and mining surveys directed to the increase of the country's resources. It has a section of applied geophysics dealing with water and mining problems. No research.

The Geophysics Department (Physics of the Cosmos) of the University of Madrid has, to date, mostly devoted itself to teaching. Only two PhD theses in seismology have been published in the last 15 years. Some research is presently being undertaken in electrical prospecting under the direction of Dr. Ernesto Orellana. The head of the Department and Professor of Geophysics is Prof. Dr. Louis Lozano (who is also head of the National Geophysical Institute). His major field is gravity. The Department includes two Assistant Professors: Dr. Rio Cruz and Dr. Brun. The seismologist of the group, Dr. Udias, is presently working on a contract basis, and hopes to receive an appointment as Associate Professor in the near future. In addition to the Geophysics group under Lozano, the Department has a Meteorology Group, under Prof. Dr. Moran and an Astronomy Group under Prof. Dr. J.M. Torroja. I believe that post of head of the Astrophysics Group is presently vacant, but I may be wrong.

As in many other countries, it is imperative that the request for funds for geophysics be included in the National Development Plan (this doesn't insure that money will be forthcoming, but it does make it nearly impossible if the request is not included). These financial plans are development through a complicated system of commissions on which all the Ministries and organizations are represented: The 1st Plan (61-65), the 2nd Plan (66-70) and the 3rd Plan (72-75). There does seem to be a gap in 1971 which I don't understand, but I hope everyone is getting his salary. Anyway, under the new development plan, I understand that a request of something like 200 million pesetas is included for geophysics, excluding geodesy. This wouldn't be a great deal of money even on the off chance that it was all made available.

If funds for geophysics projects are not included in the National Development Plan, there are two other possible sources: (1) in 1964, the Government created the el Fondo Nacional para el Desarrolo de la Investigacion Cientifica, which is not under the CSIS, but actually has more free money to support grants than does the CSIS, and (2) the Fundacion Juan March, a private concern, which does support research studies in certain selected themes. Its budget is, of course, considerably smaller than the National Fund. These sources have proven to be important to seismology, though, because the present research of Udias is supported by the first group and that of Payo by the second.

From the standpoint of international solid earth geophysics, there are three important groups: (1) the National Committee for Geophysics, (2) the National Committee for Geology and (3) what they call ICSU (International Council of Scientific Unions), which is a group within the National Research Council.

The first of these groups has 49 members, according to the list I have (but no budget). It is advisory in nature and has a number of sections corresponding to those of the IUGG (i.e., Geodesy, Physics of the Earth's Interior, Meteorology, Geomagnetism, Physical Oceanography, Vulcanology, and Scientific Hydrology). It meets at least once a year. Its president is Dr. Juan Garcia Irias, and the General Secretary is Dr. Luis de Miguel. The head of the Physics of the Earth's Interior section is Dr. Juan Bonelli (who is also head of the Spanish Upper Mantle Committee).

The President of the second group, located within the Instituto Geologico y Minero, is Dr. Eizaguirre. This group publishes an impressive annual report of work and results.

The President of the third group is Dr. Antonio Romana, and the General Secretary is Dr. Jose M. Torroja. It doesn't seem that this group does very much.

At the time of my visit a committee was being formed to look into Spanish participation in the upcoming International Geodynamic Project. Each of the first two groups had appointed two members, but the members from ICSU had not

yet been selected.

In November 1965, the CSIC established a working group to organize the Spanish contribution to the Upper Mantle Project. Two general projects were decided upon: (1) seismic profiles across the Iberian Peninsula, and (2) geophysical and geological studies from the Canaries to the Sahara coast. The first project has yet to get off the ground. During May 1967, several Spanish experts collaborated with the German group on board the METEOR during a part of the survey on the Canary Islands and neighboring seas. One should add that the vulcanology of the Canary Islands has been thoroughly studied by the Petrology Department of the University of Madrid. Perhaps, now that the Portuguese have started a program of seismic profiles, the Spanish may feel more compelled to follow suit.

In summary, Spain does have several good solid earth geophysicists, but does not support them well. A real interest and understanding of the problems of solid earth geophysics does not seem to exist above the working level. (R.E. Hanson)

EDUCATION

THE TIMES HIGHER EDUCATION SUPPLEMENT

London has done it again! Now, in addition to being a center for publishing such outstanding periodicals as Nature, The Economist, European Scientific Notes, etc., it has now come out with the Times Higher Education Supplement (THES). The first issue of this new weekly appeared on Friday, 15 October and is now delivered in the UK with one's Friday morning paper for 8p (20 US cents). Annual subscription rates to the US are $9.10 (Surface Mail), $13.33 (Air Mail to the US, followed by second class overland), $21.00 (Air Mail). These rates include one-third discounts to encourage new subscribers -- so hurry along!

The THES follows a format described in the first issue as having up to nine pages of news from Britain, up to three pages from overseas (including one page from the United States), up to four pages of book reviews for the teacher in higher education, a regular coverage of administration in higher education and a number of opinion columns.

Readers of the European Scientific Notes will be especially interested in knowing that quite extensive science and engineering coverage is being presented by the THES with a staff of one contributing editor each from astronomy, chemistry, earth sciences, engineering, immunology, medicine and molecular biology.

The science and engineering coverage of the THES has thus far been excellent -- as has everything else in the small tabloid. Included for example in the current issue (November 26) are articles on "Sussex Links with (Royal Greenwich) Observatory will Continue - (Prof. Margaret) Burbridge," "Pitfalls of Modern Physics," "Science and its Social Consequences" (Can science be neutral?). "Geriatric Research Institute to Study Aging Process." In addition there are reviews of books on physics, geophysics, genetics and thermodynamics, a weekly review on "Research" and a listing of grants made to various research groups.

Earlier issues have been waxing hot on the organization and role of the "Polytechnics" in Britain - Should staff members have the title "professor"? Are the "polys" going to swallow up the liberal art schools (some of which are now being merged with them)?

After you read a few issues you may wonder, as I did: "Why can't we have a similar publication in the States?" (J.G. Foss)

TWENTE FOR THE SEVENTIES

It has been said that Amsterdamers and Rotterdamers are inclined to think that everything worthwhile in the Netherlands happens in their municipal midsts. But in 1964 an iconoclastic event happened near the Netherlands eastern border, in Overijssel province: the opening of the first campus university in the nation, Twente University.

The Twente University of Technology is one of three technical universities in the Netherlands, the others are at Delft and Eindhoven. It is on the highway between Hengelo and Enschede on a plot of 250 acres called Driene rlo. The landscape is park-like with woods, meadows, fields and many small lakes which function both as drainage for the low-lying land and as integral parts of the architectural complex. And the architecture is certainly unusual. Willem van Tijen of Rotterdam and Prof. S.J. van Embeden of Delft were the chief architects and planners, and they with colleagues from all over the Netherlands have created a functional setting for

technological study combined with all the amenities of campus life. The basic buildings and landscaping were completed in a short two years. The Student-Staff Union and the sports hall are most impressive, designed with function in mind and excellent internal-external harmony. Two young architects have contributed significantly, Pieter Blom and Joop van Stigt, both students of Aldo van Eyck. Blom designed the remarkable Student-Staff Union and van Stigt built an equally remarkable "clubhouse" for the staff. The spatial development of these buildings is so appropriate to the campus life; it blends secret and open places into an organism which is completed only through the activities of the students.

Anyone in the Netherlands who possesses a school-leaving certificate from a qualified secondary school is eligible to work towards a university degree. The normal course takes five to eight years and consists of two parts, the first concluding with a candidaats examination which is nothing more than permission to study further for a doctoral degree in the major discipline. An innovation at Twente is the establishment of a baccalaureaat examination in place of the candidaats which, when passed, leads to the degree Bachelor of Technological Science. It also allows entrance to study for a doctorate if desired. This, Bachelor of Technological Science, then, is a new academic degree for the Netherlands, and industry has shown a great deal of interest in this innovation. The bachelor's degree can be obtained in three or four years. An engineering degree can be earned with about two years of study beyond the bachelors, and a doctorate in engineering sciences can be earned in two or more years beyond that.

Another change from tradition at Twente is the common-to-all introductory year in which mathematics and physics are stressed. The student is prevented from narrow professional concentration in this first year, and whereas optional courses in the humanities are given at other technological universities, Twente incorporates these subjects into the compulsory examination program.

Pedagogical renewal is being attempted at Twente. The syllabus is divided into four distinct educational methods: lectures, seminars, laboratories and shops, and individual study. For Dutch universities, seminars are a relatively new feature, and at Twente groups of about 20 get together with a younger faculty member to discuss and review material presented in larger lecture courses. It is believed that the give-and-take of these seminars helps break down the usual reserve of Dutch students. Another break with the past is the introduction of fixed schedules. There are two 15-week semesters per year and eight 45-minute periods per day. Lectures are scheduled in the mornings, laboratories and shops in the afternoon, and seminars, both morning and afternoon. The prescribed number of contact hours for first year students is 35 per week in the first semester and 31 per week in the second, plus 12 hours per week of individual study. Single students starting their university studies are required to live on campus for the first two years, but may opt to live off campus beyond that time. Expenses are quite reasonable; campus room f 1,368 for 12 months, lecture fees f 200, examination fees f 60 which comes to about $450 per year without board and books.

The innovations at Twente were made possible by two provisions in the special act of Parliament which established the University. The first allows it to limit the number of students admitted and the second allows the removal of students deemed unsuited to higher education. The University now has about 3000 students and is expanding only slowly since the number of applicants is not so high as anticipated, a situation which seems to exist also in the UK.

It is thought that Twente is in no wise a slavish imitation of the systems existing in some English-speaking countries. Far too much of the traditional Dutch pattern of student freedom is retained and far too many characteristically Dutch innovations have been introduced, it is claimed, to make confusion possible.

Twente is comprised of the Departments of Mechanical Engineering, Electrical Engineering, Chemical Engineering, Applied Physics and General Science. The latter Department has subdepartments in philosophy and social sciences, and in applied mathematics. Degrees are awarded in the three engineering and applied physics and applied mathematics disciplines.

A visit to the Applied Physics and General Science faculty occasioned our learning about this new University. This faculty has about 50 members with about 15 engaged in research work. The Department has about 70 students now, with 30 in the third year and the rest in the first two. Although the research program is not yet in full swing, Prof. W.J. Witteman, who is well-known for his contributions to CO_2 laser technology,

and Dr. G.J. Ernst have in just a short time been able to set up a laser research laboratory and will be producing more, new research results shortly. Their work will be described in a subsequent article.

The future plans for the University include the creation of an institution specifically directed toward complexes of problems which are of importance to the development of human society and the promotion of interdisciplinary research and instruction. Three fields of science are to be developed: technology, social sciences, and bio-sciences. The three are not envisaged as becoming fully and independently structured. In the near term, planning is centered on managerial engineering, biosciences, biomedical engineering, and pharmaceutical engineering.

Twente Technical University is quite a new type institution for the Netherlands, with new goals and new approaches. If one could validly judge commitment to academic innovation and excellence by architectural accomplishment, certainly Twente will soon become a unique and respected institution. (W.J. Condell)

ENGINEERING

MAXI ELEMENTS IN CORK

The research activities of the relatively small Department of Mathematical Physics, of the University College Cork, Ireland, centers around the interests of its chairman, Prof. P. Quinlan, in the solution of plate bending problems by numerical calculations. Because of the rather large interest in finite element methods for solving structural analysis problems, Quinlan's work may be of more than passing interest. The normal finite element technique replaces the actual structure by an arbitrary number of (small) polygonal elements, usually triangles or quadrilaterals, for plane stress problems. Characteristically only linear extensions and rotations of the element are permitted, and in the limit as the elements become smaller it seems intuitively clear that the actual structure as represented by, say, the biharmonic equation is approached. For large elements, however, this approximation may be inadequate.

Quinlan, in very recent and mostly unpublished work, has lifted the "mini-element" restriction, replacing it by a "maxi-element" one, in which a less approximate deformation mode of the element is introduced and the size of the element can be rather arbitrarily increased. He introduces a double set of exact solutions of the plate bending equation (or by an obvious analogy, extensional deformation analysis not yet programmed). The first, called corner functions, satisfy the field equation and boundary conditions along each of all of the angular corners, i.e., the two edges making the angular corner, thus automatically including corner stress singularities if they exist. The second, called edge functions satisfy the field equation and boundary conditions along each of all of the straight sides (or again by an obvious extension along curved boundaries in reasonable coordinate systems).

These two sets, however, do not necessarily satisfy boundary conditions along any of the other portions of the boundary than those for which they were expressly tailored. Hence there will be "residuals" remaining along all the boundary which must be removed by collocation or integrated least squares fit. The rather startling and demonstrated success of the Quinlan technique in many example cases stems firstly from writing all the solutions in complex forms, with shifted zeroes of the various corners of the now "maxi-elements," and secondly, from careful programming to yield surprisingly accurate stresses and deformations in remarkably short computer time. The method of analysis apparently permits quite rapid convergence, and considerably less oscillation in the solution than that experienced, for example, by Srawley and coworkers at NASA/Lewis.

The present technique seems natural for individual, built up, or sectional plate structures, and the very simple program instructions are appealing to the novice in numerical analysis. Extensions to plane stress stretching problems and three dimensional structures are now under active consideration. (M.L. Williams)

ELECTRICAL ENGINEERING AT EDINBURGH

Whatever happened to Dr. Jeff Collins? His friends in the US will be glad to hear he is alive and doing well in the Electrical Engineering Department of the University of Edinburgh. Many will remember Collins for his work at Stanford University and later at Autonetics and for his many thought-provoking scientific talks on acoustic surface wave devices (ASWD). He has been at Edinburgh for about

fifteen months, and is engaged in a research evaluation phase prior to formulating a research program of his own which will integrate well with other research interests in the Department.

During this evaluation phase, Collins has been examining with other faculty members not only to what systems and systems concepts ASWD are most appropriate, but also what should be the next generation of devices using acoustic surface waves. Some results are being obtained on the first point. Tentative conclusions indicate that certain forms of communication systems and perhaps air traffic control can benefit significantly from the use of ASWD. Examination of the second point has not yet brought forth any clear-cut answers and in final analysis may depend on results obtained for the first. In all this evaluation, Collins is attempting to be as objective and realistic as possible, and his conclusions and considerations are guided by a strong urge to have his research applicable to devices which will have commercial use.

The Electrical Engineering Department in which Collins is a professor has not yet issued its annual research brochure, the last being issued in May 1970. The reason is that the intense evaluation of the Department research has not yet been completed. There are strong areas of research in the Department now, and the future course will depend on integrating these areas and on the Department's interaction with various funding organizations.

Currently, the Department receives financial help from the Wolfson Foundation, Science Research Council, Ministry of Technology, the Poultry Research Centre, and a number of electronic companies. The Wolfson Foundation encourages the development of research groups which can assist industry and improve the education of engineers. At Edinburgh the Foundation provided £130,700 in 1969 for the consolidation and extension of activities of a group in microelectronics and systems research. It is hoped that this funding will lead to additional industrially sponsored research at the University in support of the growing number of science-based industries in central Scotland. The Wolfson grant has allowed the purchase of scientific equipment as well as laboratory and office extensions.

The Department, headed by Prof. W.B.J. Jarvis, has about 15 Academic Staff and Research Fellows, 20 Technical Officers and Technicians, and 20 Research students. It is located in the King's Buildings in Mayfield Road - new buildings a few miles away from the old, in-town University buildings one remembers from old movies of Scottish doctors. The subjects for on-going research include amorphous semiconductors, silicon and gallium arsenide epitaxy, cadmium sulphide epitaxy, resistivity of thin deposited metal films, MOS (metal oxide semiconductor) devices and circuits, electron beam technology, X-ray topography, holography for thin-film deposition by pyrolysis, microelectronic devices, and systems. The amorphous semiconductor work is much along the lines being followed at Chelsea (see ESN-25-11), but differs in that at Edinburgh facilities exist for materials preparation and characterization. The MOS work is done in cooperation with the Department of Computer Science to develop a computer - assisted design program for MOS devices and circuits.

A wide assortment of experimental facilities exist within the Department. Many vacuum systems exist for thin-film deposition. Methods used for deposition are thermal evaporation, electron-beam and DC and RF sputtering. Five high quality furnaces are available for silicon plus other furnaces dedicated to different materials. Photolithographic facilities include a reduction camera, step and repeat camera, spinners, etc., all allowing 1-μm resolution. Two special silicon epitaxy RF units are in operation. Bonding leads down to 0.0007 in. is done with thermocompression and ultrasonic bonders. A Cambridge Instruments' stereoscan Mark II, scanning electron microscope is also in use. The Department has access to a time-shared ICL 4-75 computer system, and through the Edinburgh Regional Computing Centre, it has access to a batch processing system.

Located also on the King's Buildings site are the Departments of Physics, Chemistry, Geology, Computer Science and the Poultry Research Centre. There is scientific exchange between these Departments and Electrical Engineering. Once a course of action is determined, it is anticipated that the revised research program in Electrical Engineering will be highly oriented toward the solution of real-life problems in microelectronic devices and systems. No doubt, the new program will reflect Collins' experience in the States adapted to the needs of local industry and the excellent capabilities existing in the Department. (W.J. Condell)

ASIAN INSTITUTE OF TECHNOLOGY

My visit to Bangkok, Thailand, and the Asian Institute of Technology (AIT), took place the day after a revolution there. As I was often told in Bangkok -- everything is peaceful, including the revolutions. Bangkok is peaceful -- a city of over three million, the feeling is that of a village, with only the downtown traffic sometimes belying the fact. It is a curious blend of East and West, and the Thai alphabet tends further to create a sense of the exotic for the American.

AIT is the best-known institute of higher learning in Southeast Asia. In fact, depending on the definition of Southeast Asia, it is the only such institute there. Established in 1959 as the SEATO Graduate School of Engineering, AIT became an independent institution in 1967. I was greatly surprised at its small size. Essentially, a civil engineering graduate school, its management is vested in an international Board of Trustees, with the purpose of supplying advanced engineering education suitable for the region. It is an American-style university.

The AIT provides academic programs leading to the, Diploma of AIT, Master of Engineering, and Doctor of Engineering. (The DAIT is, very approximately, half a masters degree.)

The Institute also conducts research for the solution of relevant Asian problems, as well as specialized courses, seminars, and programs.

Plans are underway to substantially expand the scope of the Institute when it moves to a brand-new campus in August 1972.

The Board of Trustees consists of 23 members from all parts of the world, and its decisions are acted upon by the President and the three Vice-Presidents of the Institute, assisted by the usual assortment of staff. At this time, the Institute is divided into the following seven divisions , which also provide the bases for the academic programs: Agricultural engineering, environmental engineering, geotechnical engineering, structural engineering and mechanics, systems engineering and management, transportation engineering, water science and engineering. In addition, there are two centers: the English Language Center and the Mathematics and Computing Center, and an excellent library. About 30 professors of various ranks are associated fulltime with one or other of these divisions or centers, and there are about 10 part-time teaching associates, who come either from the University or from government departments in Bangkok. About ten research associates assist in the various testing and research programs. All this is directed towards about 230 graduate students. The staff is now being increased to prepare for the expected 350 students on the new campus next fall.

Since the Institute is essentially sponsored by the countries of the region, and to a lesser extent by the UN, the staff comes from many countries, as do the various laboratory facilities, that is, from USA, Britain, Australia, New Zealand, Japan, and France. The students appear to be mainly Thai, Filipino, and Malaysian, although every part of Asia is, or has been, represented, even Turkey.

The curriculum is typically American, with credit-hours, and semesters; the semester system has recently been changed to one with three equal terms a year. The language of instruction is English.

In speaking with Dr. Jerry C.L. Chang Vice-President for Development, and formerly of the Univ. of Pittsburgh, I was astonished to learn that the cost of education is $8000 per student per year, with an annual budget of $2 million. The cost per student seems very high for Asia, where often a university professor himself earns only half this amount! Usually, it is the government of the student's home country that foots the bill -- the tuition itself is $1500 per term! Chang feels that one of their major problems is the high student drop-out rate after the first year, worse than a third! They are trying to reduce this to about 20%, but it seems an impossible task to me, since AIT has no experience with the graduates of some of the newer universities, and some students have little experience in using the English language. To ensure continuation of their high standards, the student/professor ratio is 7:1, and typically, the professor teaches one course per term and supervises six theses. Chang pointed out that there is a definite place for research, and that professors are encouraged to get contracts -- but, as discussed below, this is easier said than done.

The professors are usually seconded from donor countries for two-year terms, and this is counted under the foreign aid program of these countries. A total of 15 countries are associated with AIT -- usually the Asian countries contribute in the form of student scholarships. Thailand's contribution is the donation of facilities and land -- the aid for the new campus being her gift. seems to

me that, although the system of rotating appointments for the overseas professors has been necessary, the lack of continuity it creates has made growth and planning haphazard.

The AIT has no need to apologize for its facilities -- these are excellent, and generally better than those at most American schools. At the present time, the campus consists of a corner of Chulalongkorn University in downtown Bangkok, with two main buildings containing classrooms, offices, library and laboratories, most of which are air-conditioned as the climate is usually uncomfortably humid. The surroundings are pretty, and the campus of the host University is a definite advantage as it creates a larger environment and the feeling of less parochialism. Next fall, however, the Institute will move to its new 400-acre campus, about 30 miles north of Bangkok. This site is really quite isolated from the city and security may be even a bigger problem. I can't help but wonder how the move from the middle of town with all its attendant pleasures and conveniences to the middle of a beautiful nowhere will affect the recruitment of staff. The new campus is quite beautiful, and it will have housing for faculty and students alike -- but, should colleagues be together 24 hours a day? There really was no choice, as no other land was available.

The library contains about 40,000 volumes of books and other technical publications, with subscriptions to about 1000 journals. All of the usual facilities, such as microfilms and copying, are available.

AIT's six laboratories and two centers will be described very briefly,
Environmental Engineering Laboratory: basically for conducting pilot plant operations on the treatment of water, sewage, and industrial wastes.
Soil Engineering Laboratory: contains all the usual conventional equipment, plus complete equipment for soil exploration and field testing.
Structural Engineering Laboratory: has all the necessary equipment, including a strong floor with anchorage slots, to conduct a wide range of experiments on full-size and model tests. The study of concrete receives special attention.
Transportation Engineering Laboratory: facilities exist for the study of bituminous and concrete pavements, including a test vehicle. Traffic engineering studies may be made.
Hydraulics Laboratory: this is particularly large, with equipment for studying open channel flow, sediment transport, wave motion, river and estuarine models, and hydraulic structures. There is also a towing basin, as well as subsonic wind tunnels and a high-speed water tunnel. The Institute has also started an instrumented climatological station, apparently the first in the nation.
Agricultural Engineering Laboratory: under construction on the new campus, it will have both indoor and outdoor sections.
English Language Center: exists to help those students with troubles in English, the language of instruction. There are two language laboratories, quite well equipped.
Mathematics and Computing Center: is concerned with the teaching of mathematics, statistics, and the use of computers, as well as to assist with computer needs. There is an IBM 1130 digital computer, and a TR-20R analog computer, together with the usual complement of card punching machines and associated equipment. The Center has access (not by a remote connection!) to two IBM 360 machines belonging to government departments in Bangkok.

As Vice-President Chang told me, research contracts are actively pursued. However, obviously it is not too easy to obtain substantial research funds. Where would they come from? Almost all research conducted is that needed for master's theses and doctoral dissertations, and few of these studies are of the massive problem-oriented type requiring extensive personnel and huge funds. Some professors conduct their own research, separate from the advanced degree program, but again, this is not the type to need major support. The average two-year tour of duty almost precludes the possibility of major research programs, which often depend on the talented and dedicated leadership of one person. As far as I could determine, the only current sponsored research is in the area of hydraulics, concerned with the study of various local delta regions.

The research underway for the whole Institute is described in greater detail in a separate report under preparation. It is of interest to note that work is being done in the area of low-cost housing, and composite timber-concrete structures are being studied. This is a problem (and a possible solution), peculiar to this region and a good example of topical research. It is quite obvious that the research being conducted by the graduate students is of a particularly high standard. This is even more remarkable when it is remembered that academic accomplishments in Southeast Asia have not

heretofore been noteworthy.

Dr. Seng-Lip Lee, Chairman of the Structural Division and formerly of Northwestern University, discussed the substantial efforts that are underway in seeking not only research sponsorship, but also sponsorship for regional meetings, international conferences, and the like, in order to establish, once and for all, the international reputation of AIT. The new campus will contain a conference building and a small hotel (courtesy of Japan) which together with the dormatories in summer will make the conduct of conferences eminently feasible. But, he also pointed out the difficulties of attracting engineers and scientists to Bangkok, which, in my opinion, would be hard put to compete touristically with a number of other major cities in Southeast Asia. (Coincidentally, I heard from other sources that the only reason Bangkok attracts the tourists it does, is the current unattractiveness of Saigon -- it is felt that planes might not use Bangkok as a way-station when peace comes to the region.) Lee also showed me the books and technical publications of the faculty over the years -- impressive certainly, but most of the authors have long since left. I met a number of young Thai professors, recently appointed and educated either in the US or in Britain. Together with the few expatriates who extend their stay, it does seem possible that a much-needed permanent core of faculty will develop.

From my own contacts with a number of AIT graduates, I agree with Lee's opinion that the AIT graduates compare very favorably with graduates of US graduate schools. In fact, as a guide to US schools evaluating AIT graduates seeking admission I believe any graduate in the top third of his class should be a better-than-average PhD student in the States.

Life can be good for the expatriate, since his position and salary are such that he can expect excellent housing, servants, country club and the like. His life is quite busy with the everyday affairs of the Institute. But, what of his wife? Bangkok is not such a fulfilling city for a woman, I am sure. The language and the alphabet appear difficult enough that few expatriates master them, but there seems no need, since English is very universal. Additionally, there is an increasing problem of security against crime.

There is no doubt in my mind that the Asian Institute of Technology is a notable success, particularly so for a part of the world where academic success is not too common. To have started an institute from nothing, and within a decade to have graduates who can compete with anyone anywhere in the world is an achievement worthy of emulation. I am sure that this success will continue as the Institute expands -- a reflection of capable and dedicated staff who have thrived in a rewarding atmosphere. (Lambert Tall)

SYMPOSIUM ON MASS-PRODUCED STEEL STRUCTURES

123,000 square kilometers of attraction -- this is how the guide books described Czechoslovakia. I saw only a few of these square kilometers, but the natural attractions are certainly there, although usually dampened somewhat by the lack of modern conveniences.

I attended a special two-day Symposium organized by the International Association for Bridge and Structural Engineering (IABSE), as well as a concurrent exhibition by steel fabricators. Both were held in Prague in late September 1971.

This Symposium was organized by the IABSE with the help of the Czechoslovak Scientific and Technical Association and the Czechoslovakian Society of Civil Engineers, and was attended by some 300 engineers from most parts of the world, with many from the Eastern countries. I was a little disappointed that US steel fabricators were not in attendance -- the sophisticated production methods of some countries could have been inspiring, even if not very practical. The conference had been organized some years earlier, and there had been some worries in the last year that it would not take place. But, it was excellently organized, and, except for some minor inconveniences typical of Eastern countries, it was very successful. It was obvious that the normalization of relations between Czechoslovakia and the West was of prime importance, and the marvelous hospitality could not have been more open. I did not notice the extreme despondency of the people which I had been lead to expect, and, although the discussion of the political failures of the past three years was somewhat muted, nevertheless it was discussed in small groups. The large number of cars on the streets, the great selectionof goods in the stores, the relative modernity inside many homes, all indicate that this is a thriving country -- until you learn what the wage scale is, and realize that these goods are luxuries!

(How can they live so well, then?) By ignoring the political restraints and compartmentalizing their lives, the people seem to have found a way to enjoy life.

The IABSE is an international association with three official and ostensibly equal languages: French, German, and English. The Association is run by Europeans, and is headquartered in Zurich, with the French and German languages the usual forms of business communication. However, most of the publications are in English, perhaps 80%, with most of the remainder in German. The supremacy of the English language and the increasing activity of the US delegation in the Association has created the usual American-European problems. No doubt, to the satisfaction of some organizers, this conference very quickly became a German conference, with both East and West Germans very much in the lead in the presentations, both numerically as well as in the quality and sophistication of the work described. I had expected that the events of 30 or so years ago would have reduced the influence of the German language in modern Prague, but this was decidedly not so.

The purpose of the conference was to consider all aspects of the mass-production of steel structures, with particular attention to economics. As far as useful information was concerned, this must certainly have been one of the most successful conferences that I have attended -- however, the economic aspects were almost neglected. It seems that engineers can solve all the problems of the world when technical knowledge is needed -- but the introduction of the human element, or any other non-engineering facet, leaves us flapping! For some time in the more technically advanced countries, it has been obvious that the cost of labor is becoming one of the most important economic considerations in the overall cost of the building -- many new fabrication techniques and design methods have been put forward to try to scrape an extra percent or two from the overall cost.

Some readers may not be aware of one of the basic reasons for a conference such as this one -- it is that steel is in a very poor competitive position compared to concrete. Therefore, any way to cheapen the price of steel structures is of immediate interest to the steel fabricators. So it seems odd that the steel vs. concrete competition was not mentioned at all during the conference.

At first glance, it may seem logical that the use of mass-production techniques can lower costs -- but, this method can be used only for certain repetitive structures which are not too common. Even in such structures, the actual structure itself is only a small part of the overall cost -- the cost of land, of interior and exterior finish, of the various fittings, of the furniture and the rest, are major elements. I could not help but feel that a disproportionate amount of time is being given around the world to the 20% or so of the cost which can be controlled in the factory! One of the few examples of costs was that given of a British company which had built a new completely - automated factory to manufacture purlins, and which had experienced only about a 10% production saving for each purlin, despite the enormous capital outlay required. The purlins are a rather insignificant part of the overall cost of a structure -- obviously the savings in terms of the overall cost become negligible. It is my own considered opinion that a major step in the road towards cheaper steel structures will come only when the structures are designed as a unit, when all the material is put to work. This has already been started. But, until it is pursued to the utmost, the current great effort to squeeze the last few drops of efficiency out of today's steel structures can really only be an interesting academic exercise, since the various component parts of structures are usually designed separately.

An ONRL Conference Report is in preparation, and a number of facets of this symposium will be reported in detail. For this brief ESN report some highlights of interest are the following - most fabricators have little idea of modern methods, including the use of computers, to systematize the flow of materials and fabrication steps in the plant.
- there is a tendency towards less use of structural analysis, and towards an increasing use of reliability analysis. Also, structures are being designed for a specific lifetime of use, and not to rival the pyramids in longevity!
- the use of steel in mass-produced low-cost housing is expected to become an economic possibility soon --

in fact, it is already claimed to be so in Sweden. (Both the US and Swedish presentations on this topic were excellent media for presenting the Western way of life to people from behind the Iron Curtain -- how else does an engineer get a chance to show a modern kitchen to an Eastern audience without feeling somewhat presumptuous?)
- the development of a burner which uses compressed air, with gas costs cut to negligible amounts. (H. Ziethe, German Democratic Republic.)
- storage racks are one area where mass-production can be used to advantage -- in the last 10 years, these racks have increased in height to as much as 50 ft! There has been a corresponding mushrooming in their use, and they present interesting structural problems to the sophisticated engineer because of the instability problems created by the great heights and lack of lateral supports. Modern storage racks and the use of computer-controlled retrieval machinery have lead to full automation, transforming the old dingy warehouses of yesteryear completely!
- mass production requires sophisticated joining techniques, whether by welding or by the use of fasteners.

My main conclusions from the conference would be:
- the mass-production of most bridges is impossible.
- the mass-production of most buildings is not usually possible,
- and where buildings can be mass-produced, the savings to the total cost of the building is probably not worth the effort.

The Symposium was organized under the capable guidance of Prof. F. Faltus, recently retired head of the Structural Engineering Department at the State University of Prague, a giant in his country, and extremely wellknown are his structural engineering studies and designs. His closing words were: "The best thanks you can give us is to come again." (Lambert Tall)

STEELBUILT '71

This English-language word was the title given to the exhibition open during the week of the foregoing symposium. Essentially, it was an exhibition by fabricators of some of the modern methods, structures, and tools that they use. But as an exhibition, it was a complete flop!

I couldn't understand the reason for such an exhibition in an Eastern European country, nor, indeed, could my acquaintances from various Eastern countries. The only immediately obvious reason was to demonstrate to the visiting engineers that Czechoslovakia is a completely normal country. In a Western country, such exhibitions are the means for the presentation of specialties and facilities with the main purpose of attracting orders and contracts. In a centrally-controlled economy, the engineer is not usually in a position to decide on such matters. If there is a question of using Western ideas, materials, or methods, a high-ranking delegation goes to the West and inspects the working product very closely at first hand.

Although there were about three-dozen exhibitors, the booths were very tiny, and there was nothing new or exciting on display. The use of photographs was widespread, and not very inspiring. A number of Western companies were represented, including Western Gear, who had a full-size working exhibit of their "Sky Climber," an interesting window-washing platform. Even Wiley and McGraw-Hill were there, but the number of books on display was pitiful - after all, only the State has hard currency to buy Western books. Some of the leading Czechoslovak erectors and fabricators displayed interesting photographs of their bridges and buildings, but we had already seen most of them "in the flesh" during our stay.

On the other hand, considering the many restrictions in the country, the mere staging of such an exhibition must be taken as a sign that the door to cooperation with the West is open. (Lambert Tall)

MATERIAL SCIENCES

AGARD MEETING ON STRESS CORROSION TESTING METHODS

On 2 October, a BEA Vanguard crashed near Brussels, Belgium, killing all 63 who were aboard. On 28 October, confirming early speculation, the Belgian Transport Ministry announced that the bulkhead in the rear fuselage of the wrecked airplane was corroded and had a crack in it.

A few days after the crash, I attended a Specialists Meeting on Stress Corrosion Testing Methods, held 5 and 6 October 1971 in Brussels in conjunction with the 33rd Structures and Materials

Panel Meeting and sponsored by AGARD, the Advisory Group for Aerospace Research and Development of NATO. Several papers examined the structure of such organizations as the American Society for Testing and Materials (ASTM), the National Association of Corrosion Engineers (NACE), the British Iron and Steel Research Association, etc., and in particular, the manner in which these organizations make recommendations and set standards. These discussions were appropriate, since under discussion was the question of whether and what kind of standard test samples should be devised for stress-corrosion evaluation. Indeed, several experimental papers dealt with this topic. Concepts of fracture mechanics were the basis for much of the discussion, including the gnawing question of the applicability of some of these concepts. The panel's title implies a meeting of materials experts and design experts. It seemed clear, however, that the materials experts dominated, certainly in numbers and presentation of papers.

The opening paper was given by Mr. W. E. Anderson (Battelle Pacific Northwest Labs., Richland, Washington) who spoke on "Engineering Utility and Significance of Stress Corrosion Cracking Data." This was one of the few papers emphasizing design. Anderson noted several pragmatic features of concern to the designer. First, it is necessary to consider the reality of prototypes and tests. For example, can the test results meaningfully be applied to a real airplane landing gear during the complete cycle of operation? Next, what is the credibility factor of the test? Does the test simulate the high mean loading stresses coupled with locked-in residual stresses? Then, what prognosis can be made for actual performance for the real landing gear? Incidentally, Anderson noted that the first description of stress corrosion cracking (SCC) was given by Batchelder in an 1844 issue of the Journal of the Franklin Institute.

One of the important papers of the Specialists Meeting turned out to be probably the shortest, much to the credit of the speaker. The paper was "The Use of Slow Strain-Rate Experiments in Evaluating Resistance to Environmental Cracking" by Messers James E. Reinoehl and Walter K. Boyd (Battelle Institute, Columbus) delivered by the latter. In conducting environmental cracking tests, some samples will not show damage within the predetermined duration of the test and the alloy in question may be inferred to be "immune" to cracking. To determine the true degree of immunity would require exposures for times approaching infinity. Boyd suggested that relative degrees of susceptibility to environmental cracking and embrittlement can be determined as a function of the usual mechanical ductility parameters (e.g., reduction in area, elongation, etc.) or as a function of electrochemical polarization parameters (e.g., electrode potential, pH, solution composition, etc.) by pulling cylindrical tensile specimens at a suitable slow strain rate while they are subjected to controlled electrochemical and environmental conditions. Complementary microscopic examinations of the fractured specimens should then provide additional information regarding the mechanisms involved in the fracture process. The apparatus described by Boyd is relatively uncomplicated. A cylindrical tensile specimen is placed in the test cell which consists of a length of glass or other suitable inert tubing, secured between two rubber stoppers. Confined within the tubing and around the specimen is 50 ml of corrodant solution. One end of the test specimen is affixed to a stationary load cell, the other to a moving crosshead whose speed of travel can be set and controlled by a gear box powered by a 1/4 hp motor. In Boyd's apparatus strain rates in the range between 5.4 and 0.4%/hr are achieved during plastic deformation of the specimen. These strain rates conveniently induce varying degrees of stress-corrosion cracking (SCC) in mild steels in times ranging from several hours for the fastest strain rate to several days for the slowest. Boyd noted that with the arrangements described, an intermediate strain rate of 1%/hr is most convenient for screening tests on mild steels in caustic and carbonate-bicarbonate environment, since such a strain rate gives one result per machine per day. In Boyd's opinion, the faster strain rates of the usual commercial testing machines seem to be suitable only for evaluating alloy-environment combinations which are very susceptible to environmental cracking phenomena.

Incorporated in the equipment is a commercial potentiostat by which the potential of the specimen can be controlled with respect to a saturated calomel reference electrode (selected on the basis of relevant features of potential/current curves). For example, selective corrosion attack and environmental cracking are expected to be most severe at imposed potentials corresponding to negative regions in the potential/current curve. Accordingly, a few specific ranges of potentials can be selected which will optimize the chances

of occurrence of environmental cracking phenomena, and relative amounts of loss of ductility can be determined as a function of potential in each range. With the apparatus described, it is also possible to study the role of temperature upon the propensity of stress corrosion cracking.

But to return to the format of the meeting. There were five half-day sessions. Session I led off with two papers describing ASTM and NACE methods of standardization, followed by two papers on measurements. In Session II a report was given on the European Federation of Corrosion followed by three on test methods. The first of the latter, given by Mr. T. G. Gooch (The Welding Institute) examined stress corrosion testing of welded joints. Prof. R. P. Wei (Lehigh) opened Session III with a summary of the ASTM-Committee E-24 report on some important aspects of sub-critical crack growth, in other words an analysis of the application of fracture mechanics to SCC. This talk was then followed by several which examined the practical aspects of applying fracture mechanics. Attention to this question was particularly given by Dr. A. H. Priest (BISRA). SCC in various real materials, such as stainless steel, aluminum and titanium alloys, was examined in Session IV. In this session Mr. G. J. Danek revealed the importance of specimen orientation when studying high-strength aluminum alloys.

The last session, Session V, began with Prof. J. C. Scully (Leeds) reviewing the highlights of the proceedings of a NATO Science Committee Conference on "The Theory of Stress Corrosion Cracking in Alloys" which took place in Portugal in March 1971. Although I was unable to attend the Conference, I have seen the preprints which include excellent surveys, discussions and recommendations for future research. The proceedings are available at a cost of $4.00 from:

Scientific Affairs Division
NATO
1110 Brussels, Belgium

Interesting summary discussions followed Scully's talk, but much time was devoted to examining the pros and cons for developing a program to evaluate uniform and standard test methods for SCC. Unanimity was not reached on this topic and further discussion will obviously take place.

In the above resume, I have only touched on several major but highly technical aspects of the meeting, but I will attempt to deal with these in more detail in a forthcoming topical report. (E. I. Salkovitz)

MATHEMATICAL SCIENCES

THE BRITISH COMPUTER SCENE II

On 18 November 1971, the House of Commons Select Committee on Science and Technology issued a report on the British Computer Industry. The report stressed the importance of a national computer industry and recommended that £50 million per year be made available by the UK government for research and development in computers. The present level of R & D support of £5 million per year was termed "derisory."

The apparent benefactor of the Committee's report is International Computers Ltd. (ICL), Britain's leading mainframe manufacturer. Over the past few years, ICL has received little R & D support from the government. However, ICL has received a 76% share of the £47 million government computer orders over the past three years. Of ICL's share, nearly 90% went directly to the company in terms of single tender orders, which represented the government's only major assistance given to the company.

In the report, the Committee recommends the abandonment of the single tender policy. It states that single tenders are bad for the industry and bad for customer. Industry and government should purchase the equipment and services best suited for their needs, irrespective of origin. However, the Committee does not advocate dropping protectionism entirely since its first objective is the fostering of a strong independent British computer industry. Thus, it suggests a number of criteria to be used in place of the single tender approach. These include: the contribution made by the supplier to the UK balance of payments; the amount of research and development done in the UK; the degree to which the company could control its own UK affairs; the UK proportion of the shareholding; and the long term effort in the UK industry and economy. In the light of these criteria, it is likely that the UK government will continue to favor ICL in its computer orders. However, US-controlled companies, as IBM (UK), and Honeywell Information Systems Ltd. might possibly benefit from the revised approach since price and performance are important, and in some cases overriding.

The £50 million per year support

for computer R & D that the Committee recommends will bring the UK government support for its computer industry in line with French and German government support for their industries. In France, government support totaled £76.3 millions in the period 1966-71. West German government support in 1971 came to about £34 million, and for the next five years reports are that it will approach £500 million. It thus appears that all the major Western European countries are committed to strong, national computer industries.

In the past year, ICL, CII (Compagnie Internationale pour Informatique) of France and Control Data of the US entered into a joint venture by setting up a company called Multinational Data, aimed at standardization of mainframe design and portable software. Control Data and CII recently agreed to produce a new medium scale computer which will be the first product of the collaboration. Significantly, ICL refused to participate in the new design. It remains to be seen what effects this refusal will have in future projects of Multinational Data. (Franklin F. Kuo)

THE UNIVERSITY OF PARIS, INSTITUT DE PROGRAMMATION

In early November 1971 I visited the Institut de Programmation of the University of Paris. Located in a new glass and steel office block at 9 quai Saint Bernard on the left bank of the Seine, the Institute is the center for the teaching and research in computer sciences for the entire University, which is estimated to have a current enrollment of 120,000 students. The Institute, whose directors are Professors René de Possel and Jacques Arsac, has fifty-four researchers, and includes on its faculty such well-known computer scientists as Marcel Schutzenberger, Jacques Lions, and J. C. Simon. My visit was hosted by the Institute's principal hardware specialist, Jean Suchard.

The work that Suchard's group is doing concentrates on the design of small, special purpose processors by means of microprogramming. Their microprocessor, which they call a "ULM" can be readily adapted to replace small computers or wired controllers. The structure of a ULM has four types of elements: Storage- (registers and flip-flops); Processing - (a parallel 4-bit adder); Transfer - (busses); and Control - (Microprogramming matrix). The technology used in the implementation of a ULM unit is TTL logic, and the microprogramming is achieved through an NPN transistor matrix. At Suchard's laboratory, I saw a small ULM designed to drive an XY plotter. The ULM work is described in a paper presented at IFIP Congress 71 by J. Suchard and G. Bossuet entitled "Modular Microprogrammed Logical Units." At present the main effort in Suchard's group is in the development of "intelligent terminals" for use in distributed computing systems. It is envisioned that these terminals will have microprogrammed control using the ULM's and have as many as three magnetic tape cassettes for memory.

Suchard's group has helped in the design of several time-sharing systems in use at the Institute. Although the University of Paris' central computer is a CDC 3600, the Institute's students and staff mainly use the time-sharing system on an Elliot 4130 computer. The system is capable of supporting eight teletype terminals. It's main languages are Assembly, and interactive Fortran. There are also two Elbit 100 minicomputers in Suchard's area. The Elbit computer, produced in Israel, is a 12-bit machine not unlike the PDP-8. One Elbit, with 12 K memory, supports a small time-sharing system for student instruction. It has a desk-calculator mode and the only language available is Assembly. The other Elbit, with 4 K memory, is used to drive a Tektronix 611 storage tube display and a XY plotter.

On the academic side, the Institute offers a full range of courses, which, to a large extent, parallels an MS degree program in computer sciences in the US. To give an idea of what the Institute's course program is like, we will list the courses with their instructors in parenthesis. First year: Combinatorics (Perrot), Statistics (Pisot), Numerical Analysis (Jacques), Logic (Benejam), Combinational Circuits (Suchard), General Informatics (Vignes).

As we see, the courses in the first year are of a background or foundation nature. The course titles give a fairly good indication of its content except for the General Informatics course. In the second year, courses are offered in the following special areas: Compilation - Languages (Nolin), Syntax Analysis (Simon), Compilation (Chevance); Processors - System Concepts (Pouzin and Cazala), Applications and Utilization (Dupuy), Exchange Mechanisms (Suchard); Memories - Secondary Memories and File Systems (Rocher); Teleprocessing - Interactive and Display Software (Simon); Computer Structures - Logic Circuits (Suchard),

Sequential Circuits I (Hebenstreit), Sequential Circuits II (Duplessy); Operational Informatics - Operations Research (Faure), Statistics (Undecided); Applied Logic and Informatics - Logic (Benejam), Recursive Functions (Undecided); Automatia Theory and Formal Languages - Automata Theory (Nivat and Perrot), Formal Languages and Algebraic Languages (Boasson) Applied Algebra in Informatics - Free Monoids (Schutzenberger), General Algebra (Dubreil-Jacotin).

The Second Year appears quite rigorous, and it is. My understanding is that there is a certain extent of course selection permitted, but I do not know the extent.

My impression of the Institute's program as a whole is that the academic side is as good as most of the leading computer science graduate programs in the US. The theoretical research is strong, but the applied work in computer systems lags that of the US. (Franklin F. Kuo)

PHYSICAL SCIENCES

UNIVERSITY COLLEGE ACOUSTICS AND OPTICS

The work of Prof. Eric A. Ash and his associates, principally Dr. Ian Mason, at University College, London University (Torrington Place, London, WC1 TJE) is well known within scientific circles in the US, not only through his publications and talks but also through associations Ash made while at Stanford University in the early fifties and at IBM in the late sixties. The work of Ash and his associates has been described in two ONRL reports, 41-69 and 43-69, by Prof. John Shaw, and this note attempts to give more recent results in a few areas previously reported.

Acoustic surface waves can be guided along the surface of solids if there is a local reduction in the wave velocity. This reduction ideally produces only evanescent acoustic fields in a direction transverse to the direction of propagation; hence the wave is guided. Two techniques for obtaining the local reduction in wave velocity were reported by Bell Telephone Laboratories in 1967: one makes use of a thin deposited strip on a substrate having an acoustic velocity higher than the strip; the other makes use of the grooves cut into the material which give a reduction of the restraining forces in the guiding region. This latter technique has been called a topographical guiding, and the University College group has been working on a variant of the groove-type, namely a ridge guide.

Experiments were done with samples of duralumin at frequencies around 1MHz. The duralumin was machined to leave either a straight ridge which was probed with a laser system or a ring that afforded velocity information from the frequencies at which successive resonances occurred.

One mode of surface wave propagation has been reported before (see E.A. Ash and D.P. Morgan, Electron Lett 3, 462-464 (1967) or E.A. Ash, R.M. De La Rue and R.F. Humphryes, IEEE Trans MTT-17, 882-892 (1969)). This is a slightly perturbed Rayleigh mode and has velocity close to the Rayleigh velocity. A different mode has now been studied, and this is one in which the wave propagates along the ridge in snake-like fashion, a flexural mode. The lowest order flexural mode, at least in an infinite plate, is always less than the Rayleigh velocity; and in tall ridges, since there is considerable motion transverse to the ridge, one might expect a much lower velocity for the wave along the ridge than for the slightly perturbed Rayleigh mode. Indeed, this is what was found experimentally: for a ridge height to width ratio (H/W) of 3, the minimum guided wave velocity was one-half that of the Rayleigh velocity, while for H/W of one it was 85% of the Rayleigh. Of course, the waves are dispersive, but not alarmingly so.

The ridge guides formed in the shape of rings not only allowed velocity vs frequency measurements but also Q measurements. For a ring ridge with H/W of 1 and a ring diameter of 50 acoustic wavelengths, a Q of 7000 was found at 90% of the Rayleigh velocity. The Q was found to decrease with decreasing diameter as $Q \cong 140\ (D/\lambda)$, where D is the diameter of the ring and λ the acoustic wavelength. This relation has been checked down to a diameter of six wavelengths, $Q \cong 840$, which will permit guiding around very tight corners without excessive loss.

Use of the flexural mode ridge guides avoids the necessity of two different low-loss acoustic materials, and affords relatively low dispersion, low velocity, and tight cornering. It remains to be seen how high in frequency this approach to surface wave guiding can be pushed, but some applications are certainly possible now in the low MHz region, particularly for the ring resonators.

When the last ONRL reports were written on acoustic surface waves work at University College (UC), the main emphasis was on isotropic surfaces. Since piezoelectric solids are generally anisotropic and since piezoelectrics are of prime technological interest, it is not surprising to find work at UC on unguided surface wave propagation on anisotropic surfaces. The theoretical work done was not a complete analytical solution of the propagation, nor a direct numerical computation. Rather, by use of simple assumptions valid for many practical cases, approximate analytical results were obtained sufficient for designing focusing transducers and the calculation of beam-steering and diffraction losses. The technique used is the analysis of Gaussian beams in terms of plane waves with a quadratic approximation to the slowness (reciprocal phase velocity) curve. Objections to the technique might be the limits of validity of the quadratic approximation and that generally Gaussian beams are not truly normal modes in anisotropic media. It turns out that Gaussian beams remain Gaussian (even though beam-steered) in the quadratic assumption, and that in most cases of practical interest the angular distribution of plane waves is sufficiently small to allow the quadratic approximation. The results of calculations with these assumptions are quite interesting: A range of conditions from enhanced diffraction through retarded diffraction, auto-collimation and to negative-phase front curvature in the far field has been predicted from the theory. For some specific examples chosen, Bi_{12} Geo_{20} cut $\langle 111 \rangle$ with propagation in the $\langle 2\ \bar{1}\bar{1} \rangle$ direction should exhibit quite good auto-collimation, while InAs cut $\langle 1\bar{1}1 \rangle$ propagation in $\langle 1\bar{1}0 \rangle$ and GaAs cut $\langle 111 \rangle$ propagation in $\langle 2\ \bar{1}\bar{1} \rangle$ should show negative wave-front curvature.

Using the theory, the UC group has designed a focusing interdigital, Gaussian weighted transducer for use on quartz. The experimental findings seemed to confirm theory rather well, but as expected significant aberration did appear at the focus.

By using the laser probe system, first described in Shaw's reports, the UC group has been able to plot out the acoustic field distributions for various surface wave propagation situations. An acoustic lens was fashioned by depositing a thin metal film for the lens on a piezoelectric substrate and the focusing effectiveness was measured with the laser probe. The first lens design had serious aberrations, but a new design, just measured, shows excellent focusing properties. While it is much too early to evaluate the eventual applications for acoustic surface wave lenses, the UC group holds some hope that fast-Fourier transforms could be done with the lenses after ways have been developed both to put the information on the acoustic beam and to detect the transform in the focal line.

As is the case with similar research groups in the US, the UC group is also doing some work in integrated optics, a rather natural evolution for an acoustic surface wave research group. Ash has been working on a diffraction grating for light propagating within a piezoelectric material. The diffraction grating is an interdigital transducer deposited on the piezoelectric material with the fingers parallel to the light beam. Fairly good diffraction efficiencies have been obtained. In addition, Ash will be attempting to perform some elemental functions on the optical beam which should have wide applicability such as beam division, followed by multichannel modulation, followed by beam recombination.

Dr. I. Mason has been working with cadmium sulfide attempting to make a "convolver," i.e., a device to perform mathematical convolutions. Since the gain saturation observed in acoustic surface wave amplifiers has been due to the depletion of the background space charge under tight bunching conditions when high acoustic fields are present, it was reasoned that the electron-phonon interaction in piezoelectric semiconductors could be used just as anharmonic piezoelectrics have been for nonlinear acoustic surface wave processing. Mason used CdS since he could vary the conduction electron density by light illumination, and has constructed convolvers at 17 and 50 MHz. The convolved output signal was observed well above the levels of spurious signals generated by traveling second harmonic waves and lattice anharmonic effects. (W.J. Condell)

PLESSEY TELECOMMUNICATIONS RESEARCH LABORATORY

On a beautiful day in early November 1971 I visited the Plessey Telecommunications Research Laboratory in Poole, Dorset. Plessey is a large conglomerate company which has recently

been reorganized in terms of businesses, of which Plessey Electronics and Plessey Telecommunications are but two of many. There are about 200 people working in the Laboratory which serves as the applied research arm of the Plessey Electronics and Telecommunications manufacturing plants located on the Poole site. Plessey communications is primarily engaged in manufacturing equipment for the British Post Office Telephone Service. As such, Plessey Communications might be likened to Western Electric Company in the US, or more closely to Nippon Electric Company in Japan. There is also a small similarity between the Plessey Telecommunications Research Laboratory and the Bell Telephone Laboratories in the US. However, since Bell Labs are much larger, the parallel only holds for the Telephone System Development area of Bell Labs. and the Plessey Laboratory. My visit to the Plessey facility was necessarily short, but I was able to observe some vignettes of the work being done there.

My first visit was with Dr. Peter Finney who is second-in-command of the research program at the Laboratory. Finney said that the research emphasis of the Lab was more applied than basic. If a project has little relevance for the immediate future, it is usually given up for investigations with more immediate payoffs. Most of the support money for the Laboratory comes from a central pool of funds dedicated to research and development from within the company. The amount of contract research with government agencies such as the Ministry of Defence and the Ministry of Posts and Telecommunications is relatively small, but growing. In his personal research, Finney is interested in developing a management information system (MIS). In some preliminary studies on work productivity, he was able to identify certain troublesome workers on an integrated circuits production line. With a number of promising experiments concluded, Finney is ready to apply his ideas to all of the computer-aided design (CAD) projects under his direction.

I met a number of people working on computer-aided design of logic circuits. Among these were Dudley Hull, Eric Purslow and David Bricknell. Over the past few years, there has been an extensive development effort in the design automation of logic systems at the Laboratory. The system, which is nearly completed, consists of an Input Processor and Compiler, a Data Base, a Logic Circuit Simulator, a Logic Circuit Synthesis package, and a Printed Circuit Layout Program. Plessey Telecommunications Laboratory is working jointly with the CAD group under D.G. Lewin of the Department of Electronics, University of Southampton. Lewin's people concentrate mainly on sequential circuits, while Plessey deals principally with combinational. Another distinction is that Lewin's interest is mainly in the academic side of the logic design area, namely the generation of bistable input and excitation equations for sequential circuits, starting with the assigned state table. Lewin's programs are then used as a "front-end" to the overall logic circuit design system at Plessey. Purslow, who is the Plessey counterpart to Lewin, is concentrating on the input processor which is to be written in an APL-like language. The aim of the effort is to enable the design engineer to describe a logic system in a high-level language- in this case, a register transfer language. The entire Plessey CAD system, with the exception of the input language processor, is in steady use and has found ready acceptance by the design engineers. Incidentally, another description of Lewin's work is to be found in the report on EUROCON 71 (this issue of ESN). Lewin has recently been appointed Professor of Electrical Engineering at Brunel University, near London. R. G. Bennetts has been appointed Lecturer at Southampton to take over Lewin's efforts, and will work with Plessey.

I also had a chat with Heinz Lemke who is working in data base design. Lemke recently rejoined Plessey from Cambridge University where he developed a data base, named PIXIE, for use in an interactive CAD system. The system, named RAINBOW, is used for on-line design of electronic circuits with a DEC 340 graphics console. Lemke has extended the data base design to the logic system package at Plessey. With the size and complexity of integrated circuits growing almost exponentially, correct data base design for logic system simulation and synthesis has taken on new significance. It is anticipated that both the Southampton and Plessey groups will integrate this new data base within their systems. Since both facilities have ICL computers - a 1907 at Southampton and a 1903 at Plessey - software portability should present no problems.

Among some of the other projects I saw at Plessey were: a read-only holographic memory system, a vehicle detection system for use on British Rail, an inventory re-order system using a

"data-pen", and an optical character recognition system. I did not pick up many details on these projects - especially the holographic memory, which the company is not anxious to publicize at this moment. The last three projects are commercial development projects with little new in terms of scientific innovation.

In summary, my visit to Plessey Telecommunications Laboratory gave me an opportunity to observe the inner workings of a British industrial development laboratory. I came away with the impression that although the work is not glamorous nor profound, it is nevertheless important and competent. (F.F. Kuo)

EUROPEAN PHYSICAL SOCIETY

During 14-17 September 1971, the First European Conference on the Physics of Condensed Matter was held with emphasis on metals as materials and phase transformations as physical phenomena. The Conference took place in the Palazzo dei Congressi, Florence, Italy, and was sponsored by the European Physical Society (EPS) and by the Italian National Research Council (CNR), through Gruppo Nazionale di Struttura della Materia (GNSM), a group coordinating research in the fields of atomic, molecular, liquid and solid state physics in Italy.

Comments on the beautiful city of Florence and its myriad treasures would be akin to gilding the lily, but I would be remiss if I did not write a few words about the lesser known Palazzo dei Congressi. The Palazzo, originally a villa of neo-classical architecture, is in the middle of a small park near the main railway station and is a short walk from the center of town. First-rate facilities were provided for the meetings, and especially is this the case for the main auditorium, where excellent acoustics and comfort are afforded the audience. The grounds are attractive, permitting the visitor to stroll leisurely and chat with companions about many things including the physics of condensed matter. Mention should also be made of the elegant inaugural reception which was held at the famous XIV century Palazzo Vecchio on the second evening of the Conference. After a few short speeches from representatives of various scientific and civic bodies, the Mayor of Florence welcomed the attendees to a cocktail party provided by the city.

Each morning of the Conference began with a plenary session with two invited papers given in each. After a coffee break, contributed papers were offered in four simultaneous sessions. The afternoon sessions began with invited papers in two simultaneous sessions, followed again by contributed papers in the four sessions. All in all 217 papers were listed in the regular program plus 26 post-deadline papers. There is not space here to list even the 34 invited papers, but a roster of their authors shows some of the most prominent names in solid state physics today.

One of the first invited papers was that of Prof. G. Busch (ETH-Zurich) who spoke on "Electronic Properties of Liquid Transition Metals." (The reader who wishes to pursue this subject should consult N. Cusack "The Electronic Properties of Liquid Metals," Reports on Progress in Physics XXVI, 361, 1963, for an excellent summary of the experimental and theoretical state of affairs up to the time of the article.) When examining the Hall effect, 17 out of 21 metals show free electron behavior in the liquid state as already predicted by Mott in 1935. On the other hand, the electrical resistivity of several metals which are normal in the solid state show anomalies in the liquid state. For example, the resistivity of the liquid monovalent metals is too high on the basis of simple free electron theory. In 1961 Ziman presented a theory which used the Born Approximation and incorporated appropriate pseudo-potentials in the calculation for the resistivity. This now explains the behavior of the monovalent metals above and below the melting point. But the behavior of the transition metals is more complicated and even more so when alloying elements are added. Busch presented data of his group on a variety of properties including resistivity, Hall coefficient, magnetic susceptibility and their temperature coefficients for a variety of transition metals and their alloys as well as rare earth alloys. Much of this material was given in detail in subsequent contributed papers by his students and associates. He rationalized the behavior of the transition metals in the liquid state on the basis of a filling of the 3d band and similar arguments for the rare earths. In the discussion period, Professors Byron Cole and Jacques Friedel took exception to the simple d band filling model, and Professor John Ziman suggested that he preferred not to distinguish between s and d electrons, but rather between s-like and d-like scattering.

On the second day an invited lecture on Liquid Crystals was given by Professor P. G. de Gennes (Orsay). In the study of certain large organic molecules, one

does not go directly from the solid to the liquid but passes through many intermediate or mesomorphic phases. It was George Friedel in 1922 who defined three of these: nematic, cholestric and smectic. In the nematic phase the molecules are aligned in a preferred uniaxial direction and have interesting optical properties, although they are not polarized, and no ferromagnetic nematic crystals are known. However, by the application of a magnetic field, the molecules can be aligned and a single crystal obtained. In the cholestric phase the molecules are in sheets and, if one looks in a direction normal to the sheets, the molecules seem to be arranged in a spiral fashion along that direction. The sheet arrangements are sensitive to temperature, pressure, magnetic and electric fields. They show Bragg reflection and optical rotation but are very difficult to produce in single crystals. The third phase, the smectic was studied by P. Friedel, son of G. Friedel. In the smectic phase the molecules are found in layers which may be deformable. An intensive study on liquid crystals is now being conducted in the laboratory at Orsay headed by J. Friedel, son of P. Friedel--a third generation scientist! De Gennes first discussed some of the work in East Germany relating to deformation in the smectic phase and then went on to describe work at Orsay including his own theoretical studies, as well as recent light-scattering experiments carried out with liquid crystals at MIT (in which birefringence was induced by an AC field).

In his invited paper Dr. W. Albers (Philips, Eindhoven) reviewed Composite Materials. He discussed oriented growth in situ by means of eutectic, monotectic and eutectoid reactions as well as discontinuous precipitation from supersaturated solid solutions. This was followed by a discussion of a variety of applications in superconducting and semiconducting devices. Next came a paper by Prof. P. Goy (Ecole Normale Superieure, Paris) on Cyclotron Resonance at High Frequency in Metals. It is well known that the use of higher frequencies increase the experimental accuracy in cyclotron resonance studies of free carriers in metals. Goy described his work in the range of 70 to 500 GHz; most previous work has been in the 10 to 75 GHz range. In this frequency range Goy could obtain photon energies near the Debye energy of the metal studied and gave experimental evidence of the frequency and temperature dependence of electron-photon interactions in lead.

High-performance, high-temperature nickel base alloys have a 30-year history, and this was reviewed by Dr. R. J. E. Glenny (Teddington). To an audience composed largely of physicists not in this field, he described the need to satisfy other criteria in addition to strength; e.g., corrosion, thermal and vibrational fatigue and toughness, and demonstrated the merits and limitations of dispersion strengthening and fiber strengthening. Additional invited review papers of interest to metallurgists concerned point defects, metal surfaces and a historical survey of various aspects of plastic deformation.

J. Friedel in his paper examined narrow d band behavior in some transition metals, alloys and compounds, analyzing in turn cohesion and superconductivity of pure metals, magnetism and transport properties of ferromagnetic alloys and the anomalous properties of A15 compounds. This paper was then followed by two rather specialized papers, "Scattering Processes on the Fermi Surface," by Prof. A. Seeger and E. Mann (Stuttgart) and "Electromagnetic Waves in Metals," by Prof. V. G. Skobov (Leningrad).

In the above I have dealt with the invited papers alone. They were supplemented by a number of related contributions which usually supplied useful and important details. In view of the simultaneous sessions, regrettably I cannot comment on the sessions that dealt with theories of phase transitions, semimetals, magnetic transformations, ferroelectric transitions and several others. But lest this be construed as criticism, I wish to quickly commend the Secretary of the Conference, Prof. G. Boata (Institut di Fisica, Genova) and his colleagues for organizing an outstanding conference on the condensed state, a very extensive (and intensive) field, indeed.

An addendum. On the plane trip back to London, I engaged in a bit of numerology. There were 541 who had pre-registered for the Conference, and they came from 30 countries, 243 papers were presented by representatives from a total of 26 countries. In the table below I have broken the data down a bit further. I have ranked the first nine countries according to the number of papers presented and compared this with the number attending from these countries. Finally, I have taken the ratio of these members and listed them in the last column.

	Papers		Attendees		
	Rank	Number	Rank	Number	%
UK	1	43	1	91	47
Italy	2	27	3	65	42
Netherlands	3	26	5	50	50
France	3	26	2	81	32
Germany	5	24	4	58	41
Switzerland	6	18	6	42	41
Israel	7	15	8	20	75
USA	8	10	10*	13	77
Belgium	9	9	7	24	38

*Sweden had 16 attendees

Excluding US and Israel scientists, it appears that approximately 40% of a nation's delegation to the meeting were authors on papers delivered at this meeting. It would be amusing to try this analysis on some other large international meeting. (E. I. Salkovitz)

(We look forward to hearing of additional tests of Salkovitz's law! - Editor.)

EUROCON 71

EUROCON 71, the Region 8 Convention of the Institute of Electrical and Electronics Engineers (IEEE), was held 18-22 October 1971 at the Palais de Beaulieu, Lausanne, Switzerland. The IEEE is a transnational society with a number of geographical regions. Region 8, which organized EUROCON 71, comprises Europe, the Middle East, North Africa, and the USSR. A number of national electronics engineering societies supporting the convention were: Austria, Belgium, Denmark, France, FR Germany, Great Britain, Greece, Italy, Norway, Sweden and Switzerland. The Convention Chairman was Fritz Eggiman of Switzerland and the Technical Program Committee was Andreas Rannestad of Norway.

The technical program for EUROCON 71 included about 200 papers, organized into subconferences in the following topics: Information Processing in Large Systems, Long Distance Communications, Solid State Circuits, Distribution of Electrical Power, Bio-Medical Engineering, Electronic Time-Keeping, and Computer Application and Control. Each subconference was split into separate sessions. The largest subconference was on Long Distance Communications with twelve sessions, and the smallest was on Computer Applications and Control, with only three separate sessions. Each session chairman together with the subconference organizer invited or selected the papers within his session. From talks with several of the conference organizers, we learned that virtually all of the contributed papers were accepted. Consequently, the quality of the papers was not consistently high; moreover, many papers presented were tutorial or survey in nature. These tutorial papers were generally not organized by acknowledged leaders in the field so that many lacked breadth and insight. In fairness to the conference organizers, however, it should be noted that the Convention was intended primarily to bring European engineers together to discuss European, rather than US, solutions to engineering problems. There were a number of good papers presented at the Convention. Among them were:

"COMSAT Future Plans for Satellite Communications," by R. D. Briskman (COMSAT Corp.) In this survey paper, Briskman discussed plans for domestic US satellites, direct broadcast of TV to homes and CATV pick-up points, and the next model communication satellite, INTELSAT V. The US domestic system will have six satellites. Large cooled and uncooled and small terminals can be accommodated. Aeronautical services will include communications relay, location and navigational aids. INTELSAT V, designed for a capacity in excess of 5000 channels, is expected to become operational by the middle of the decade.

"Information Processing for Traffic Control," by D. C. Gazis (IBM, Watson Res. Center). About a dozen cities in the world are using some form of computer control of traffic. Any system of this type must contain detectors, local controllers (usually lights), a computer, and a system monitor. Detectors are usually of the magnetic or light sensing type, and give a rough estimate of the number of vehicles passing by and their velocities. Gazis discussed the Toronto and San Jose experiments and some interesting New York City and Holland Tunnel experiments. In the latter case, slowing cars entering the tunnels during congested times prevented bunching, subsequent spreading and slowing of traffic.

"A Computer Algorithm for State Table Reduction," by R. G. Bennetts, J. L. Washington and D. W. Lewin (Dept. of Electronics, Univ. of Southampton). In this paper, Bennetts described the work at Southampton University on the computer-aided design of sequential logic systems. In connection with this effort a computer algorithm for state table reduction has been developed. The program

consists of the following routines: Input of the state table; generation of compatible state pairs, construction of maximal compatible classes; and extraction of closure function. The program is written in a list processing language ALP which is, in turn, embedded into the ICL 1907 version of FORTRAN II.

Finally, we reproduce in its entirety an abstract of a talk "Is Money for Safety Unlimited?" by A. K. Dobbie (Dept. of Health and Social Council, London.) "Safety Committees in many countries appear to aim at perfection in electrical safety by recommending every known safety measure to be taken irrespective of cost. In the United Kingdom no patient has died from electrocution in the past 10 years; no increase in expenditure on safety measures is therefore considered to be necessary." It should be noted that Dobbie's talk was advertised in the printed program as "Safety and Security (general survey paper)."

Summaries of other papers at the Convention will be given in a separate Conference Report in which details of the program will also be found.

An interesting feature of the Convention, of which neither of us took advantage, was the extensive program of technical visits and excursions. During the five days of the Convention, visits to 30 companies, research laboratories, and universities were arranged. The list included Brown, Boveri & Co, Ltd. at Baden, Battelle Institute of Geneva, Electro-Calcul at Valais, and the Federal Polytechnical Institute at Lausanne.

A well-printed 500-page digest of papers is available through the IEEE Inc., 345 East 47 Street, New York, N.Y. 10017.

Originally, the Convention was to have included a large electronics industrial exhibit. However, political pressures from various European trade associations forced the cancellation of the exhibit. We feel that the exhibit would have considerably enhanced the technical aspects of the Convention.

Finally, it should be noted that the IEEE Frederick Philips Award donated by N. V. Philips Gloeilampenfabriken of Eindhoven, the Netherlands was awarded for the first time at EUROCON 71. Its recipient: Frederick Philips himself. (I. G. Kinnie and F. F. Kuo)

MISCELLANEOUS

SURSUM CORDA, PISCATORES

A hundred years ago Punch addressed the Thames as follows.

"Filthy river, filthy river,
Foul from London to the Nore,
What are thou but one vast gutter,
One tremendous common shore.

All beside thy sludgy waters,
All beside thy reeking ooze,
British folks inhale memphitis
Which thy bubbly bosom brews.

. . . . . .

And from thee is brewed our porter,
Thee, thou gully, puddle, sink!
Thou vile cesspool art the liquor
Whence is made the beer we drink."

But that was a century ago. A recent issue of The Times shows a photograph of Sir Desmond Plummer, leader of the Greater London Council. He is happily clutching a small carp, perhaps six or eight inches long. Not much of a fish, but as a portent of the future, it's a prize catch. It is one of an unspecified larger number caught between Waterloo Bridge and Wandsworth in an official "fish-in" conducted to estimate the benefits of recent anti-pollution measures. It's a long, long while since it was worth an angler's time to wet a line in that stretch of the Thames. Things may be looking up. (J.M. Leonard)

NEWS & NOTES

FIRE AT SOUTHAMPTON UNIVERSITY

No one was injured, fortunately, but extensive damage was done to a laser laboratory at Southampton University when fire broke out the night of 24 November. The laboratory was one where parametric oscillator and non-linear optics research was done. It also contained offices for researchers in fiber optics communications, and their research records were destroyed (see ESN-25-10). The Guardian reported the damage as over £100,000. Prof. R.C. Smith, well known in the US and especially to the NRL laser scientists, is concerned that fellow scientists in the US know that he and his associates were not injured. He now has a major job to establish another laboratory and to get on with his research, a task in which the University is aiding exemplarily. This unfortunate accident comes at

a time when Smith's research was at a particularly productive stage; we hope that this setback will be of very short term. (W.J. Condell)

UNDERWATER SYMPOSIUM

The Biologische Anstalt Helgoland, Helgoland, West Germany, has recently announced an International Symposium for 20-24 September 1972 which may be of considerable interest to individuals and institutions with varying interests in the marine environment. The Symposium "Man in the Sea - in situ Studies on Life in Oceans and Coastal Waters," is expected to include considerations of underwater observations and experiments on microbial activities, algae, invertebrates, fishes, sharks, dolphins and whales, as well as a consideration of biocoenoses, ecosystems, and/or zonations. A second major aspect will include problems and progress in the realm of "Underwater Aquaculture." The third major topic is the role of underwater technology in marine biological and fisheries research, including a consideration of manned underwater habitats and submersibles, recording and sampling devices, and design of experiments as well as similar topics for unmanned devices. The fourth major topic will be medical aspects of underwater research, including human physiology. American scientists interested in more specific information on the Symposium should contact Professor Dr. Otto Kinne, Professor and Director, Biologische Anstalt Helgoland, Helgoland, Germany.
(John D. Costlow)

SYMPOSIUM ON COMPUTER GRAPHICS, BERLIN, 19-21 OCTOBER 1971

A symposium on Computer Graphics was held in Berlin at the Congress Hall, 19 through 21 October. Although basically a German affair, there were attendees from most of the western European nations, US, Canada, Hungary, and Yugoslavia. Of 20 papers presented, eight were in English and the remainder were in German. Unfortunately, no translations were available for these texts.

In the main, most papers were concerned with new algorithms for three-dimensional graphics, the use of multiple interactive terminals for large-scale industrial usage, and various industrial applications in the field of computer graphics.

A sampling of papers were: 1) GUN: The Interactive Graphic Unit of CISE (Perna, Italy); 2) Hardware Aspects of Computer Graphics (Giloi, Berlin/U, Minnesota); 3) A Scheme for Software Paging of List Data Structures (Hubbold, Gt. Britain); 4) Surface Representation in Engineering Practice by means of Graphic Displays (Walter, Munich); 5) HUNCH: An Experiment in Sketch Recognition (Grossier/Taggart, USA); 6) Data Structure for Graphic Data Processing (Encarnação, Berlin); 7) Interactive Graphics Systems (R.J. Dowe, USA).

A highlight of the three-day symposium was the reception given the attendees by the Senator for Science and Arts at Charlottenburg Palace.

A complete set of the papers can be obtained from: Gesellschaft für Mathematik und Datenverarbeitung m.b.H. 5205 St. Augustin, Schloss Birlinghoven, West Germany. (R.M. Dowe, Jr.)

NEW SPANISH UNIVERSITIES

According to the Times Higher Education Supplement of 3 December 1971, Spain's third national economic development plan, which begins early in 1972, includes the ambitious project of creating six new universities in three years.

Madrid, which already has two universities, will have two of those planned, one of which will be dedicated exclusively to "Free Studies" designed to fit the needs of those who cannot attend full-time regular university courses. A third university will be established in the Western region of Extremadura and will concentrate primarily on studies that link South American nations with the mother country. Other universities will be established in Cordoba and Malaga in the South and at Santander in the North.

The plan also calls for the establishment of new university faculties in five Spanish cities as well as new departments at many of the existing universities. Other aims of the plan call for the building of new facilities and the expansion of old ones, for basic education, in order to raise the general level of culture. This improvement of the educational system over the next three years will cost Spain approximately £600 million - making education the biggest item in the national budget.

Research and development - listed in the budget as a separate item - will also be supported to the amount of £88 m and some of this money will go to the universities. The part that the univer-

sities will play in the field of scientific investigation and development, however, is somewhat limited. The summary of the plan specified: "Basic research will be stimulated at the universities, higher polytechnical institutes and centers of investigation, and efforts will be made to orient their research activities in the experimental sciences, as far as possible, toward those areas which will have favorable repercussions in agricultural, industrial or fisheries production." (Stress is on practical rather than basic research.) "...efforts will be made to mobilize investigation which is particularly directed toward technological development. For this purpose projects will be chosen in those areas of research which have the most bearing on fields in which the greatest relative advantages exist..."

The official summary of the plan states: "The central interest in education arises out of the new viewpoint which looks upon education as an investment and not as an expense. Thus, increasing the cultural potential of the society as a whole becomes a matter of prime importance."

PERSONAL

A bit of news about members of our present and past staff: The name of Dr. Seymour L. Hess will appear in the next issue of Who's Who in America; Dr. Franklin F. Kuo has been elected a Fellow of the IEEE; CDR Bart Dalla Mura has been awarded the Navy Commendation Medal for work performed as the Terrier Missile Officer at Port Hueneme, Calif. We welcome aboard LCDR A.E. Victor who has recently reported as Airborne Systems Officer in the Naval Applications Division; LCDR Victor has just completed his doctorate in Physical Acoustics at Brown University, Rhode Island. Prof. Eugene C. Haderlie, Liaison Scientist for Marine Biology at ONRL, 1962-63, has received the first annual $1,000 Excellence in Teaching Award; Prof. Haderlie is a biological oceanographer at the Naval Postgraduate School, Monterey; the award is named after retired Rear Admiral John J. Shieffelin (USN) of New York.

Among the recipients of the 1971 awards of State Prizes of the USSR for science and technology are the following well-known scientists: L.D. Fadeev, for his work on the non-relativistic quantum theory of the scattering of charged particles; E.P. Aksenov and G.N. Duboshin, for their work on the perturbed motion of natural and artificial satellites and of asteroids, and on the formulation of the earth's gravitational field; Academician L.A. Artsimovich and his team for their theoretical and practical work on high-temperature thermonuclear plasma; Corresponding-Academician D.I. Blokhintsev and his team for work on the fast-neutron impulse nuclear reactor; G.E. Ovsepyan and his team for development of the "Nairi" computer; Academician G.A. Razubaev and N.S. Byazankin for work on the synthesis of metallo-organic compounds; T. Kh. Margulova for her book Atomic Power Stations, and A.P. Kreshkov for his book Principles of Analytical Chemistry.

Mr. H.A. Maxwell, Prof. D.H. Valentine, Mr. Hew Watt, Prof. A.D. Bradshaw and Prof. C.D. Pigott have been appointed members of the Nature Conservancy, in succession to Sir Henry Beresfor-Pierse, Mr. R.B. Verney, Profs. R.O. Buchanan and A.R. Clapham and Sir Charles Connell. Mr. A.E. Smith has succeeded Mr. R.B. Verney as Chairman of the Conservancy's Committee on England and Prof. K.M. Clayton and Mr. Stanley Cramp have joined the Committee, from which Prof. J.T.Coppook, Dr. S.M. Walters and Mr. J.R. Herbert have retired.

Dr. G. T. Goodman, University College, Swansea, has been appointed to the chair of applied biology in Chelsea College, Univ. of London, and Dr. O.M. Wrong, University of Dundee, has been appointed to the chair of medicine tenable at University College Hospital Medical School. Dr. Lionel E. Mawdesley-Thomas has been appointed director of the Huntingdon Research Centre, Huntingdon, England. Prof. Henry Thomas Flint, professor of physics from 1944 to 1956 at Bedford College, Univ. of London, died 24 November. He was appointed Emeritus Professor in 1956. He was known to many generations of students through his textbook - written in collaboration with B.L. Worsnop - on advanced practical physics, and for his lucid textbooks on geometrical optics and on quantum mechanics.

Dr. Glenn H. Jung, Professor of Oceanography at the Naval Postgraduate School, Monterey, California, is spending the current academic year on sabbatical leave as Visiting Professor at the Institute for Physical Oceanography, University of Copenhagen, Denmark. The

Institute, under the directorship of Prof. Nils Jerlov, has recently moved to a new location at Haraldsgade 6, Copenhagen. The Institute currently employs three scientists, including Jung, and one engineer, and has an average student enrollment of ten per year. The primary research emphasis is on optical oceanography, a field in which Jerlov is preeminent. (K.E.Slayman)

The National Centre of Tribology at Risley, Warrington, Berks., has been awarded a contract by the European Space Research Organization (ESRO) to study the requirements of a tribology laboratory for space applications. Preliminary investigations will also be undertaken into problems of drive mechanisms in space. The study contract includes identification of the problem areas in achieving a satisfactory lubrication system for satellite-borne bearing mechanisms and a definition of the organization, equipment and initial program for a space tribology laboratory.

ONRL REPORTS

The following reports have recently been issued by ONRL. Copies may be obtained by Defense Dept. and other US Government personnel, ONR contractors, and other American scientists who have a legitimate interest. Requests for ONRL reports should be addressed to: Commanding Officer, Office of Naval Research Branch Office Box 39, Fleet Post Office, New York 09510, or the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314

R-46-71 Orthogonal Functions in Numerical Weather Prediction: Some Research in Denmark and Finland, by S.L. Hess

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